GAS

DECEMBER 1959

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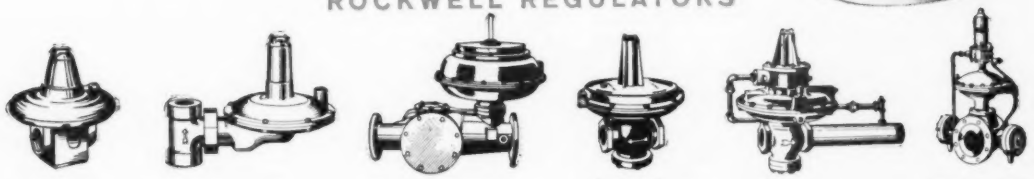

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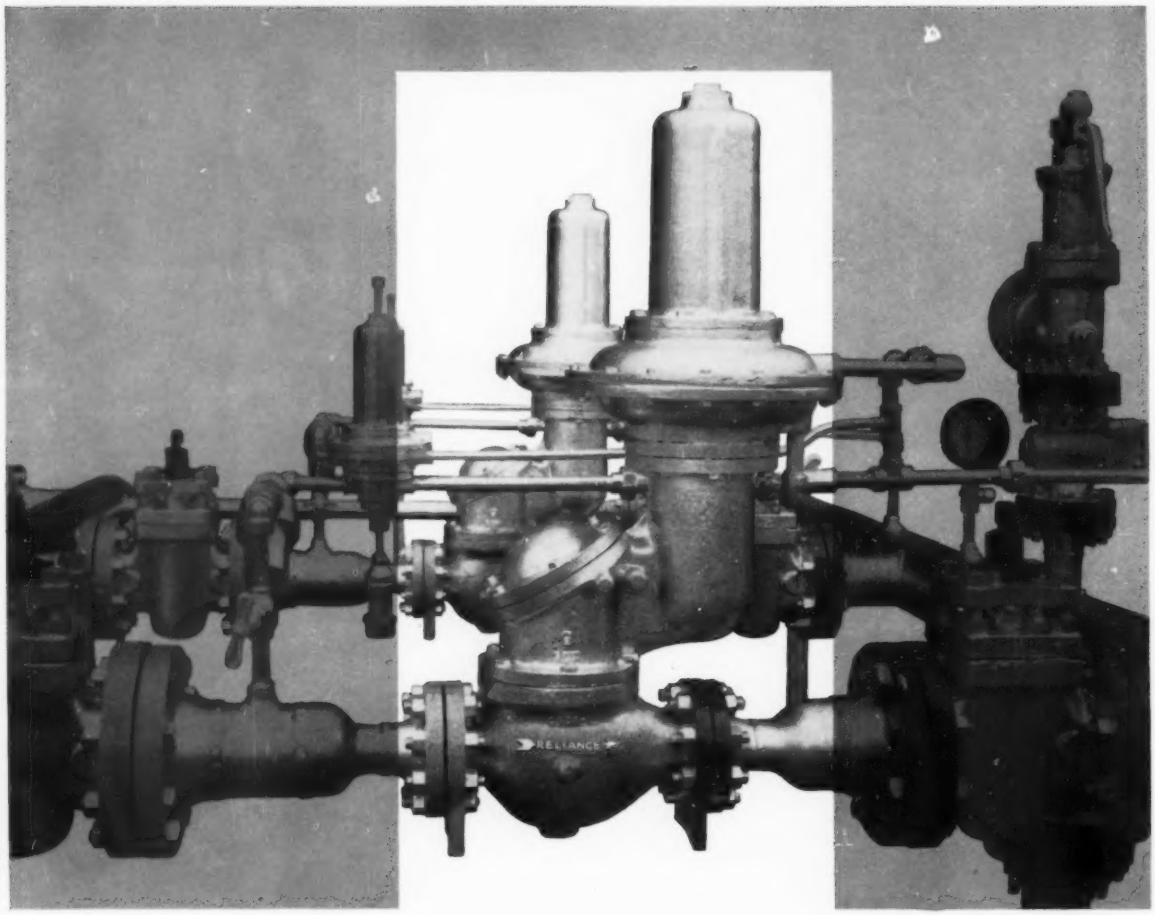

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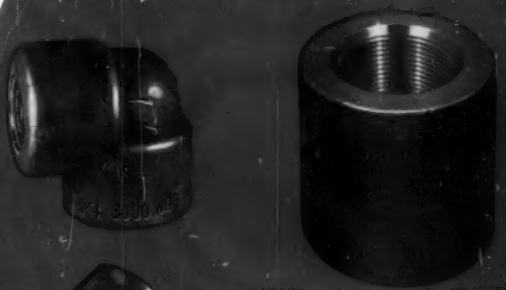

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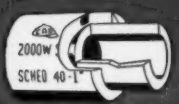

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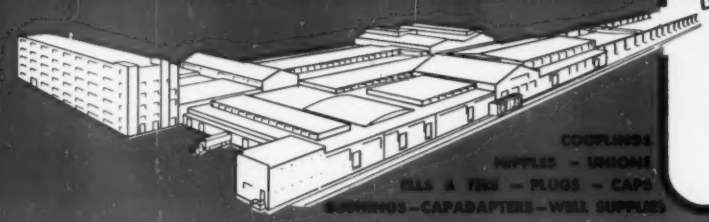

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COLUMBUS, OHIO

GAS

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BPA

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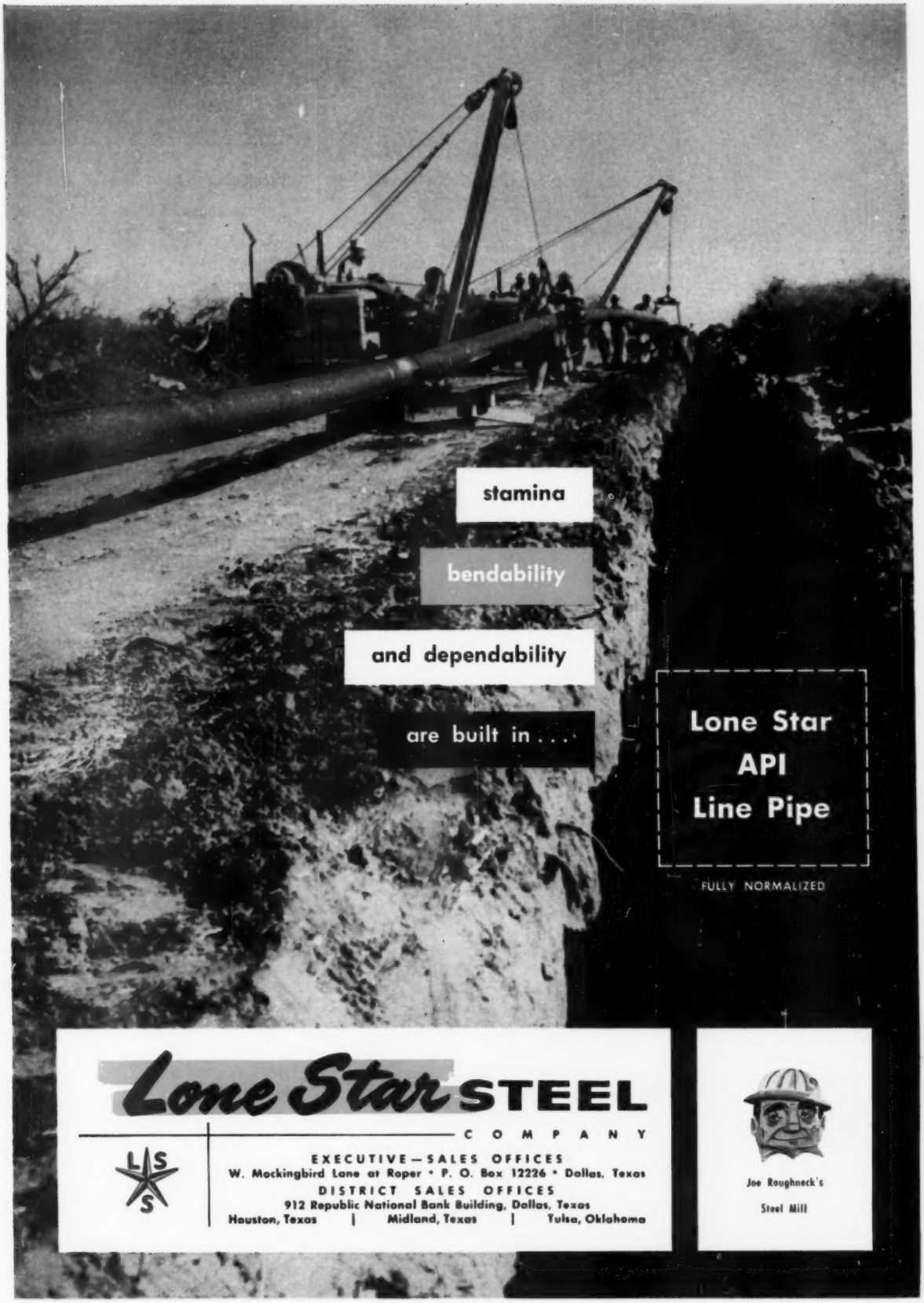

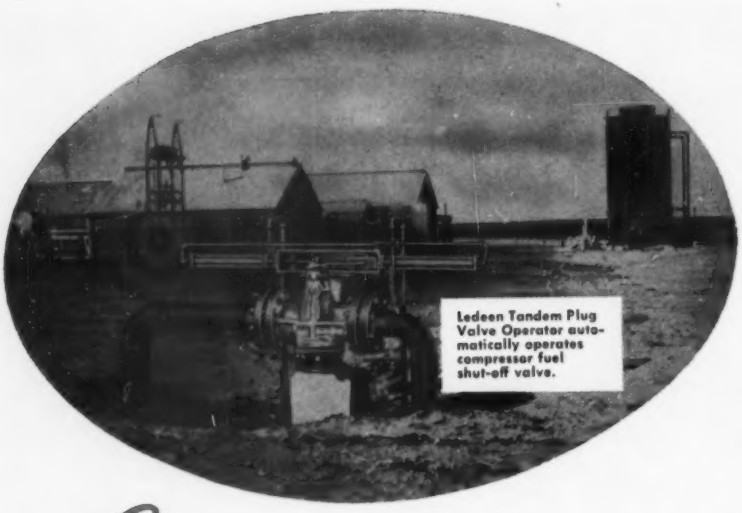

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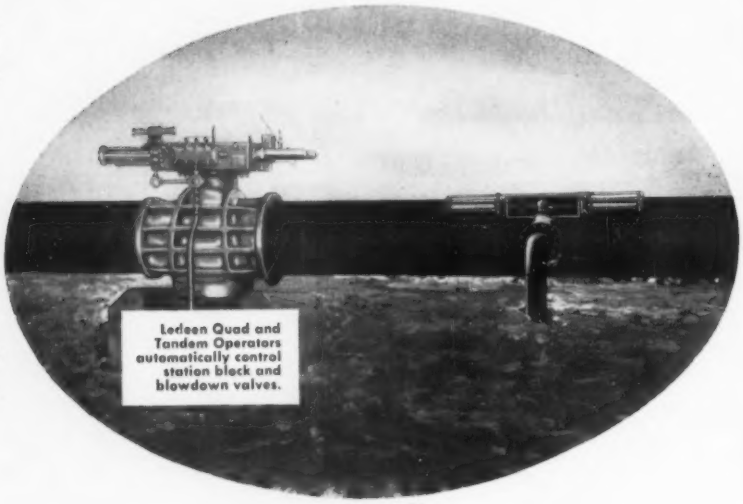

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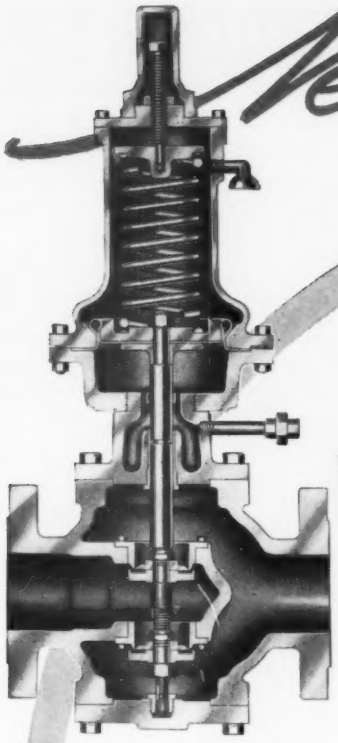

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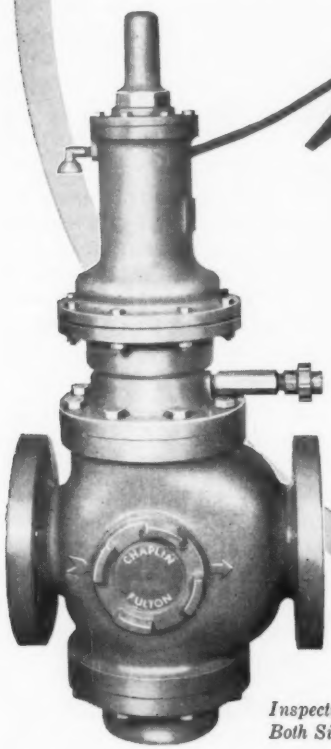

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59-2

GAS

DECEMBER 1959

Thermally Thinking

THE Greeks had an unusual application for natural gas. Over a natural seep, they set a choice priestess on a tripod. She breathed the wonder fuel and became light-headed. This produced all manner of sayings—some that made sense and more that did not. But, her words were taken as gospel. Thus, the inspiration for the famed Oracle of Delphi was natural gas.

Perhaps this method of enchantment has been carried over to modern times. Certainly some people who talk about the gas business leave the impression that they have been sniffing the gas pipe.

The fortunes and foibles of gas producers are little understood, for instance. This situation has changed since the 1930's when there was surplus natural gas all over the Southwest. Flared gas (surplus) vanished with the early 1950's. And the producers have attempted to make natural gas (nearly always produced in association with liquid petroleum) at least pay its part of the joint costs of exploring and drilling for gas and oil.

But the Supreme Court, after reviewing the operations of just one producer, said in 1954 that all gas producers—except those in strictly intrastate operations—are public utilities. Thus the farmer, doctor, indian chief or anyone who sunk a few bucks in a successful wildcat well joined other unlikely candidates such as Phillips, Gulf, Texaco, Standard, Sun, etc., as public utilities—like it or not.

So. Mr. Gas Producer hits a well. Perhaps a year later (a not unusual period) he has both a contract with a pipeline company and a price approval from FPC. But he sold to a gas pipeline that goes to another part of the country. Distributors up there, joined by a PUC or two, enjoin FPC in a federal circuit court asking that the producer's price be rolled back. If that court refuses, off they go to the Supreme Court.

Two, three or even more years may elapse while all of this is going on. During this time the producer has a real problem. He can deliver gas at his FPC-approved price or he can wait out the Supreme Court. If he does deliver, he can't cancel his contract and keep his gas, even if the court tells FPC to roll back his price so that he must sell for less than the cost of production. Or, if he waits for the high court's decision, gas pipeline and distributors and consumers lack his gas through one, two, three or more winters. Who wins? Nobody.

If FPC and the courts do not give producers enough revenue from gas sales to justify their operations, producers are going to get into another business. This is bad because we have a worldwide oversupply of petroleum. The oil industry can easily fill its requirements from worldwide sources. Should this happen, domestic exploratory effort will suffer. When exploration is curtailed, it follows that natural gas reserves will drop and drop fast. And you can't revive exploration programs overnight.

It seems to me that it is short-sighted indeed for FPC and some distributors to attempt to keep producers' gas prices unrealistically low. It does help the distributors competitively today, but it forecasts a sorry future for all of us.

Obviously, the Natural Gas Act that was developed in 1939 when there was no gas industry on the scope and scale that we know it today, and which was specifically written to regulate cross-country pipelines —not gas producers—is not adequate. Congress alone can supply the remedy. The remedy must be based on the best thinking of all three segments of the gas industry, looking ahead toward the mutual progress of all, but never forgetting the public service obligations to consumers.

Merry Christmas and Happy New Year!

J. Fred Ebsen

EDITOR

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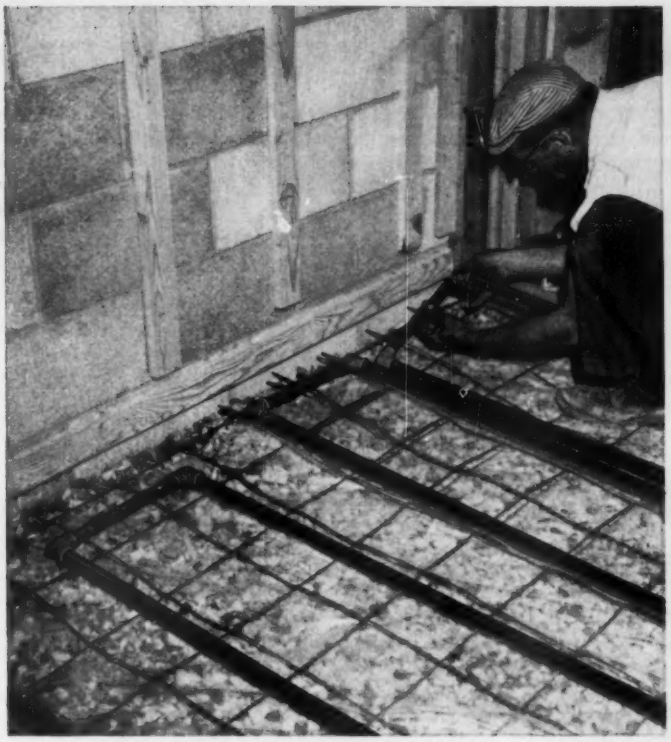

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GAS HIGHLIGHTS

Transwestern Rolls

Construction of Transwestern's 1300-mile Texas-to-California pipeline started Oct. 26. Log-jam was unblocked in early Oct. when Gulf Oil accepted FPC price conditions. Gulf will supply about 50 per cent of the gas. Other producers quickly followed Gulf's lead. Some price details have to be worked out. Pacific Lighting Gas Supply Co.—to move the gas from the California border to Los Angeles—will start its construction from Needles to Newberry in the spring. PLGS has ordered pipe from Kaiser Steel. First gas should enter the L. A. Basin before Aug. 10, 1960.

Midwestern to Roll

After more than four years of effort, TGT's Midwestern Gas Transmission subsidiary has FPC approval to bring Canadian natural gas to certain communities in North Dakota, Minnesota, Michigan, Wisconsin, Iowa, Missouri and Illinois. Their 504-mile, 24-in., $53-million project cannot be built, however, until (1) regulatory bodies in Canada approve the export (everyone is optimistic on this coming through before Jan. 1, 1960); (2) some pricing matters are absolutely nailed down; and (3) Midwestern has filed its final financing plan with FPC so that the latter can set a rate of return. (See p. 134 for details.)

Making Gas from "H"

A New England utility has started commercial operation to make base-load gas in a Hasche set with a new feedstock. The new "H" fuel being used is a hexane-heptane fraction produced by Sun Oil Co. The utility is making 700-Btu, 1.02-sp.gr. gas with, apparently, no gum or tar formation. It is reported that the operation is superior to a similar one by an affiliated company that has been using butane for the past five years.

Transportation Gas a Step Nearer

In a very important decision, the Third Circuit Court of Appeals reversed the FPC decision that said Consolidated Edison (New York) could not purchase 50 MMcfd of Gulf Coast natural gas and have Transco move it through its pipeline system to a Con-Ed plant in New York, there to generate both electricity and utility service steam. FPC can now take it to the U. S. Supreme Court, or issue the certificate. If the latter happens, Transco is ready to expand its system by $23 million to handle the "transportation" gas. Many other projects and plans for transportation gas are awaiting the final outcome. The same is true if the high court upholds the lower court's ruling.

AGA Predicts

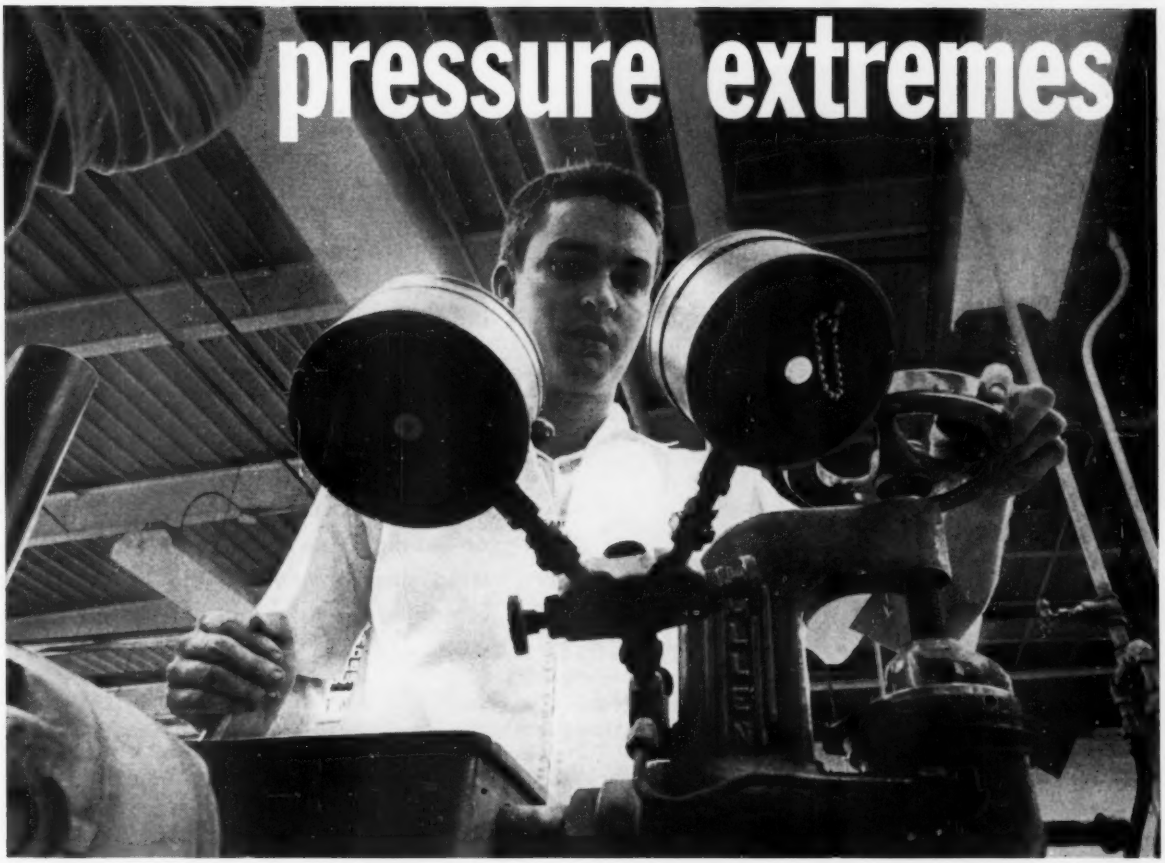
Some golden years are ahead for gas, according to the AGA's Bureau of Statistics. Dan Parsons and crew say that our industry will launch construction programs costing an estimated $34.4 billion—yes, that's BILLION—between first of 1959 and end of 1970. The breakdown: $16.4 billion for transmission; $10.9 billion for distribution; $3.4 billion for production and local storage facilities; $2.3 billion for underground storage; and $1.4 billion for construction of general facilities.

Pipeline miles will grow from 571,500 at end of 1958 to 911,508 at end of 1970. For the same period, distribution main mileage will increase from 165,400 to 282,400. Gross plant will grow—with allowances for normal retirement—from $18.1 billion to $49 billion during the same time. Instead of the 31.2 million customers served on the average during '58, the gas industry will be supplying some 44.5 million. The largest gains will be made in the commercial gas sales area where a 154 per cent increase is expected. It looks like residential gas sales will climb by 108 per cent while industrial gas sales soar by 89 per cent.

Another Prediction

Tom Hall, president of General Geophysics Co. (Houston) and new prexy of the Society of Exploration Geophysicists, told a group of Los Angeles gas and oil writers that though exploration field work is now lagging increasing demand for natural gas and petroleum, he expects exploration to keep adequately in phase with the nation's future energy demands.

you don't worry about pressure extremes



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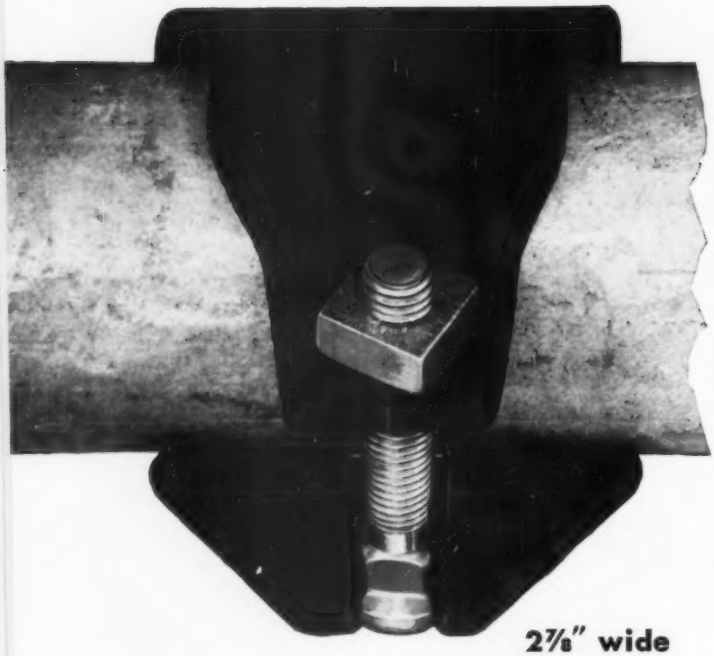

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Lug on gasket half is slotted

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SKINNER-SEAL JUNIOR EMERGENCY PIPE CLAMP

A new pipeline to California

CALIFORNIA, with its large and growing population, is one of the choice markets for natural gas in the nation. There is no commercial coal, so gas and oil furnish California's thermal energy requirements.

FPC recently authorized a new 1800-mile pipeline system costing $192 million to share that market. El Paso Natural Gas Co. is the sole out-of-state supplier of natural gas to California. It supplies 70 per cent of the total volume of gas used by customers in the entire state.

Now Transwestern Pipeline Co. will supply part of the market in the southern half of California. El Paso is presently delivering 2-billion cfd of natural gas to the distributing companies in California. The new Transwestern line will deliver 300 MMcfd to southern California. Transwestern's pipeline will receive gas from independent producers in the Panhandle and Permian Basin areas, and deliver it to the California-Arizona border.

FPC reduced the contract prices of the independent gas producers, relaxed the minimum take-or-pay obligation undertaken by Transwestern's customer, and certificated a major new pipeline with a relatively short 13-year gas supply.

• Initial price conditions for independent producers

FPC reduced the gas prices of the independent producers after concluding that they had failed to prove that the new high price levels in the contracts are required by public convenience and necessity.

The FPC said that the Supreme Court in its CATCO decision held that price is a consideration of prime importance in producer certificate cases and that a most careful scrutiny and responsible reaction to initial price proposals of producers is required.

The Court, however, recognized the commission's authority to condition certificates in such manner as the public interest requires. The substantial showing required by the CATCO ruling, the commission concluded, has not been made in the present proceedings. Therefore, such price conditions will be attached to the certificates of the producers of this high priced gas as are reasonably required to "hold the line" and protect the gas-using public against any further increase in the general level of prices paid for natural gas in these two major producing areas.

Gulf Oil Corp.'s sale of Puckett-Ellenburger gas, which constitutes 45 per cent of Transwestern's committed reserves, was conditioned on a reduction of the initial price from 12 cents per Mcf to 11 cents. The costs of treatment and shrinkage of this gas must be borne by Transwestern. These costs vary from 4 to 8 cents per Mcf, but no firm measure of these costs is available in the record, the FPC said. Other sales in the same area and requiring similar treatment are made at 11 cents per Mcf before treatment.

Authorizations of the following gas sales were also conditioned upon a reduction in the initial prices: Richardson & Bass' sales in Winkler County, Texas, from 21.8 cents to 18 cents; Union Oil of California in Eddy county, N. M., from 20 cents to 16 cents; nine sales in the Panhandle-Hugoton area from 23 cents to 17 cents; and Warren Petroleum Corp. in Wheeler county, Texas, from 23 cents to 17.

Cities Service Gas Co. proposed a sale of gas to Transwestern from a point on its pipeline for a period of five years at a straight rate of 21 cents per Mcf. The FPC, in conformity with its practice to require satisfactory cost data in support of proposed rates by pipeline companies, conditioned Cities Service's authorization upon the filing of a satisfactory rate schedule and service agreement.

Commissioner John B. Hussey dissented to the conditions imposed on the producer certificates "because of my firm belief that a policy of price differential predicated upon depth ranges would be beneficial in encouraging the search for the development of new gas reserves, without disrupting the established price of gas produced from shallower gas reserves, and because I feel that the producer prices prescribed in the majority opinion are not sufficient to provide the incentive for such deeper development."

FPC first conditioned the independent producer certificates to require a waiver of the timing advantages of Section 4 rate increases. Cities Service decided that the certificate offered by FPC was not acceptable and abandoned its part of the project. After petitions for rehearing were filed by the producers FPC announced:

"Upon reconsideration, we are of the opinion that the producers should be given the opportunity at an early date, in proceedings supplemental to these certificate proceedings, to introduce such further evidence as they deem desirable in the light of the *Catco* decision, including evidence of costs, to show that their proposed initial contract prices meet the test of public convenience and necessity. For that purpose, we shall . . . provide for a prehearing conference before the

Continued on next page

presiding examiner . . . at which time those producer applicants and other parties, including staff, who desire to participate in such supplemental certificate proceedings may appear and give notice of their intention to participate, and at which time a date for hearing in the supplemental proceedings will be fixed. Staff and interveners shall have an opportunity in such supplemental proceedings to cross-examine and to introduce such further evidence as they deem necessary.

"This procedure should be more expeditious than proceedings under Section 4(e) of the Act, and all parties can thus readily avail themselves of any relevant evidence that is already in the record. We make it clear, however, that, by allowing this further hearing concerning initial prices to proceed in these dockets, rather than pursuant to Section 4(e) of the Natural Gas Act, we are not relaxing or reducing the degree of proof which will be required to sustain any increase in the initial prices. We are only specifying a procedure which may give all parties wider latitude in the kind of evidence which may be presented. In order for applicants to sustain their proposed initial prices under this procedure, the evidence must be as convincing as it would be in a rate proceeding under Section 4(e), although it may be of somewhat different character.

"If at the conclusion of such supplemental proceedings the Commission determines that the public convenience and necessity require initial prices different from those set forth in ordering paragraph (E), upon which the certificates issued to the producers by Opinion No. 328 are conditioned, we shall modify the certificates accordingly, and shall require the producers whose certificates are so modified to amend the initial price provisions in their contracts of sale to reflect the initial prices so found by the Commission to be required by the public convenience and necessity."

This new procedure is fair to the producers, because they will have a chance to prove that they are entitled to higher contracted prices before the pipeline is completed. Transwestern requested a year for construction, so if the producers' price proceeding progresses rapidly the final price can be determined prior to gas deliveries.

Commissioner William R. Connole dissented on the reopening of the proceedings, declaring that the FPC should not "at this late date" afford the producers "a chance to prove once again what they have already failed to prove." He said that in his judgment the record now contains everything the producers should have a right to place in it, and asserted that the commission should reach "a definitive binding judgment on the initial price at which we find the public convenience and necessity requires this sale to commence." He said the FPC ought to issue such an order now, "not after another protracted proceeding which will largely duplicate existing evidence."

Commissioner Arthur Kline filed a concurring statement, but said that with one exception he was exceedingly doubtful that a rehearing would serve any useful purpose. He said that while he was of the view that the FPC should reconsider its action on one of Gulf Oil Corp.'s proposed prices, he felt that the prices proposed by other producers "so far exceed any previously contracted prices in either the Panhandle or West Texas areas and certification of these prices will have such an adverse effect on the consuming public supplied by gas from these areas that only clear proof that the price conditions imposed in Opinion No. 328 will result in confiscation would cause me to modify that opinion."

• Take-or-pay and make-up provisions

Considering the minimum obligation of the single customer to take gas from Transwestern or pay for it, FPC said in its rehearing order:

"Transwestern objects to the imposition of the condition . . . requiring it to change the minimum bill provision in its tariff so as to provide for a 75 per cent minimum bill rather than a 100 per cent minimum bill proposed. Transwestern contends that it cannot economically or feasibly market its securities with the 75 per cent minimum bill provision, but that it could finance its project with a 91 per cent minimum bill provision similar to that which El Paso Natural Gas Company (El Paso) has in its tariff for the delivery and sale of natural gas to the same California distribution companies which will receive Transwestern's gas. Transwestern indicates that it would accept a reduction in its minimum bill to 91 per cent, and that it would accordingly reduce the contractual make-up period from ten years to five years so as to make its arrangement compatible with El Paso's. Also Transwestern has attached to its application for rehearing a copy of a letter from Pacific Lighting Gas Supply Company (Gas Supply), its sole customer, agreeing to a 91 per cent minimum bill with five year make-up period, and indicating the concurrence of the affiliated distribution companies for whom it is purchasing the gas.

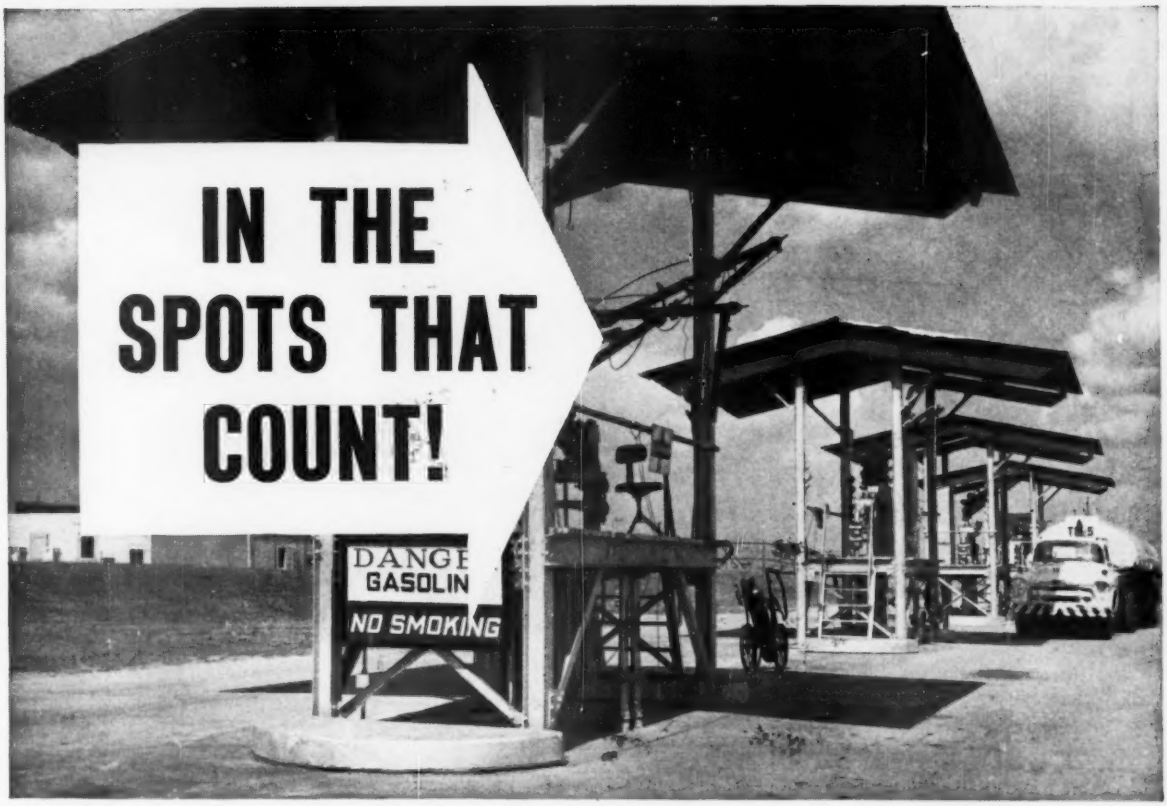
"Inasmuch as El Paso has a 91 per cent minimum bill for gas which it sells to these same distribution companies, and it appears that a similar provision would protect Transwestern from discrimination in the event of market fluctuations and insure the financing of its project, we shall modify Opinion No. 328 and the accompanying order by requiring a reduction in the proposed minimum bill from 100 per cent to 91 per cent, instead of to 75 per cent, and a substitution of a five year makeup period for the proposed ten year period."

In other cases, FPC has authorized new pipelines or additional capacity to existing pipelines with a 75 per cent minimum bill provision. Presumably, if the California customers of Transwestern and El Paso find the 91 per cent minimum bill obligations to be a burden in the future relief could be obtained from FPC.

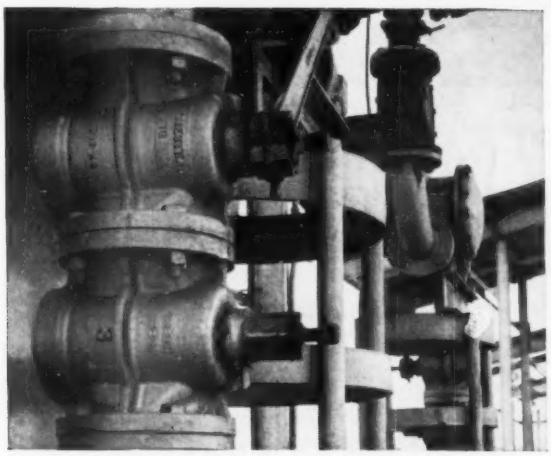
• Thirteen-year gas supply

In recent years FPC has relaxed its earlier requirement that a long-term natural gas supply and deliverability be proved for new major pipeline projects. The Transwestern project is a good example. FPC reasoned thus:

Continued on page 92



Homestead Plug Valves Help to Keep Aviation Gas Pure at Naval Air Base, Norfolk



3" Homestead Lubricated Plug Valves handling gasoline on tank truck loading docks at Naval Air Station, Norfolk

Aviation gasoline must be kept free of contamination. That's why fuel lines on truck or ship loading docks, and on underground storage tanks, are so often controlled by Homestead Lubricated Plug Valves.

Controlled pressurized lubrication system and extremely close tolerance between plug and body, prevent lubricant from being extruded into line—prevent contamination of gasoline. Add Homestead's reinforced Teflon* head seal and double ball check valve, and you have a truly dependable plug valve—one that opens quickly and fully for fast loading; closes quickly and tightly for positive fluid control.

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TECHNICAL TRENDS

By GUY CORFIELD

Wide uses reported for gas chromatography

It was only a few years ago that gas chromatography was advocated as a practical analytical tool (see Technical Trends, GAS, March 1957). Already, however, a wide variety of apparatus has been developed by laboratory equipment manufacturers. These instruments will assertedly permit analytical work that was not possible, or at least much more difficult or time consuming, by previously available methods.

Gas chromatography is a method of separating and identifying components in a mixture of gases, or liquids that can be gasified. The gas or vapor is swept through a separating column by means of an inert carrier gas such as helium. The column is packed with granules of an absorptive material such as activated charcoal or silica gel, or an inert substance coated with suitable chemicals. Components in a gaseous mixture are selectively adsorbed and separated in the column so that they move through at different rates. As each emerges it can be identified by its thermal conductivity, and its volume measured.

Instruments now available vary from a portable indicating battery-operated type selling for about $500, to large recording cabinet-size duplex installations costing over $10,000. It is stated that time for an analysis varies ordinarily from 10 minutes or less to a little over half an hour. Samples can be as small as 1 to 2 ml of gas; 0.001 to 0.005 ml of liquid; or can be several hundred ml of gas so that relatively large volumes of each of the separated constituents can be collected.

To give an idea of the asserted versatility of these instruments, the following uses have been reported: rapidly checking composition of plant streams in an oil-field light hydrocarbon processing plant, thereby greatly assisting efficient operation; determining composition of a crude oil sample, doing in 12 hours what formerly took several months; separating compounds having boiling point 1 deg. or less apart; analyzing tastes and odors by isolating and identifying responsible trace components. These claims and statements from instrument manufacturers, and users, indicate considerable enthusiasm.

The Institute of Gas Technology has been exploring the usefulness of gas chromatography to the gas industry. While endorsing it as "capable of providing gas analyses of good accuracy," it is more cautious in its evaluation. The institute's News Letter of April 1959 states in part:

"The increasing use of this method for fuel gas analysis has emphasized the need for standard procedures acceptable to the gas industry.

"During the past 18 months the institute has developed what appears to be adequate procedures for gas chromatographic analysis of natural, reformed and oil gases, and liquid petroleum gases (LPG), and work in four areas is planned for 1959:

"(1) The natural gas method will be field tested by members of the project supervising committee in their company laboratories. Upon acceptance by them, it will be submitted to the American Society for Testing Materials for consideration as an ASTM Standard Method. The methods for analysis of reformed and oil gases, and LPG, will then be field tested.

"(2) Accurate analyses by gas chromatography require frequent calibration of the instrument, and are time-consuming. Study will be made of simpler procedures with slightly reduced but industrially acceptable accuracy. The effects of such variables as carrier gas flow rate, temperature and pressure on the calibration stability of certain types of detectors will also be determined.

"(3) On the basis of the results of the above study, work will be undertaken toward improvement of flow rate and pressure controls for the instrument, and tests will be made of various types of detectors.

"(4) Work will be undertaken on the development of methods for determination of part-per-million concentrations of trace components in gases. Such a method would be particularly valuable for analysis of odorants in natural gas."

Gasoline bricks

The Russians are reliably reported to have developed a process for making "solid" gasoline in the form of bricks, which seems to offer advantages for transportation and storage under certain conditions. Actually the bricks are a fine-celled honey-combed plastic container in which the liquid gasoline is carried like honey in the comb. A casein-formaldehyde structure is used, with tiny cells with diameters of a fraction of a millimeter.

The overall brick is claimed to contain about 95 per cent gasoline. It is resistant to weather and temperature (120 deg to −70 deg F), and water. It can be burned as a solid. Regeneration of liquid gasoline is done by squeezing in a specially designed press, small enough to be part of a moving vehicle, with a gasoline loss claimed to be only 2-3 per cent.

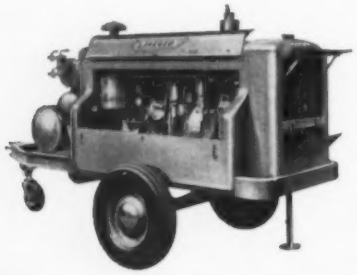
DRILLING GAS MAINS UNDER PRESSURE: Jaeger "125" rotary compressor powers a Mueller C1-36 Drilling Machine, drilling a 10" main under pressure, preparatory to installing line stopper plug. The unfluctuating pressure maintained by the Jaeger rotary insures a uniformly accurate cut, vital for proper seating of the inserted plug.

Jaeger Rotary maintains constant pressure at slower operating speeds

Jaeger compressors produce the same volume of air as other rotaries at 100 to 350 rpm slower engine speeds. Full load speed is only 1700 rpm, compared with 1800 to 2150 rpm in others. This higher Jaeger efficiency saves horsepower, saves fuel, saves engine and compressor wear.

Instantaneous air delivery and smooth, stepless speed modulation enable a Jaeger rotary to maintain 100 lbs. constant pressure under all normal operating demands.

8-hour fuel tanks, full size tool boxes and retractable pneumatic tired dolly wheel are standard on all 2-wheel models. For complete data or demonstration, ask your Jaeger distributor or write for Catalog JCR8.



JAEGER "250" — biggest rotary compressor on two wheels. 4-wheel units to 600 cfm.

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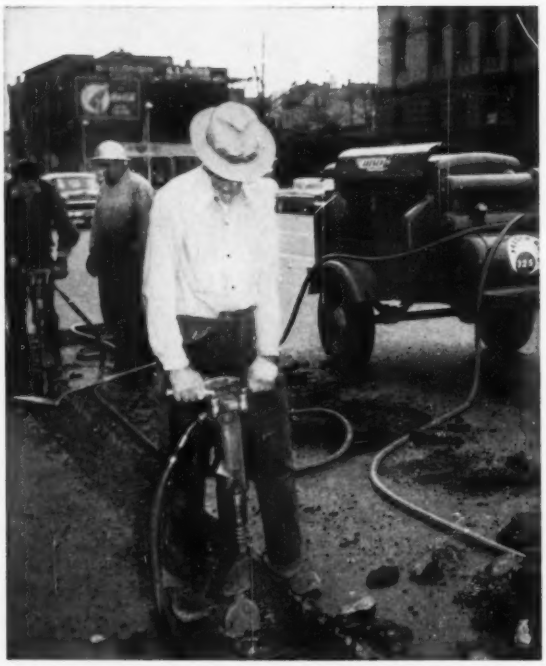


FAST TRENCHING: Jaeger "125" maintains full pressure in two #25 Thor breakers. Speeds trench cutting and other work with power tools.

WASHINGTON

By NEIL REGEIMBAL
GAS Washington Bureau

Gas bill needs more than Seaton's support

NEW natural gas legislation is going to have to get a lot more than the endorsement of Interior Secretary Seaton before it stands a chance of passing, congressional insiders make clear.

Even strong support for a gas decontrol measure by President Eisenhower, although necessary, won't be enough, they say.

Capitol cloakroom strategists say there is virtually no chance that any gas industry legislation, no matter how it is drafted, will get through in 1960. In the first place, such special interest legislation rarely makes the grade in an election year. And this particular measure still wears a stamp of "anti-consumer," even though it is not justified.

Even more important, however, are the politics of the 1960 session of Congress. Northern liberals of both parties took a real licking last year from the coalition of conservatives and the fence-jumpers when the labor reform bill was passed. They aren't about to take another licking on anything with as little popular support as gas legislation.

Chances for the measure in 1961 are obscure and will remain cloudy until after the 1960 elections. The makeup of the new Congress and which of the many candidates gets a temporary home in the White House will tell the story.

The flurry of optimism Secretary Seaton stirred up by endorsing gas legislation at the American Gas Association convention in October when put under the cold hard light of day is assessed by most Washington pundits as a political move aimed at showing the gas industry that the Republican party would be their eventual salvation.

Secretary Seaton is one of the brightest "young men" in the GOP camp. In addition, he sits in what has generally been the hot seat of Administration political strategy, and he has often been used to put out fires and to light them.

Most of the push for the gas bill has traditionally come from southern conservatives, and most of them are Democrats. The GOP is trying to offset this imbalance of support. And, in addition, offset the industry's belief that the President threw them to the political wolves two years ago in vetoing a gas bill only on the basis of the Case incident, which had no bearing on the merits of the measure Congress had passed.

This is not to say that Secretary Seaton and the President do not support gas legislation. They do, although hardly in the form which the gas industry would want if it had its choice. Nor is their support particularly enthusiastic.

Seaton made it clear that the Harris gas bill, now sitting in a pigeonhole in the House Commerce Committee, is not yet in a form which would draw the wholehearted support of the Administration.

He told the AGA that he hopes that the industry will "take the lead in seeking appropriate legislation which will insure a more realistic basis for the relationship between the Federal Power Commission and your industry and at the same time protect the interests of the consumers of natural gas."

He is not for decontrol, but rather appears to favor increased control over pipelines and continued government control over producers, although on a more realistic basis. And he also indicates that some control over what he terms "uneconomic" uses of gas, such as at dump prices for boiler fuel, be strictly controlled.

Close reading of the Secretary's "major policy speech" at the AGA convention also indicates that the Administration is moving behind the coal industry's bid for a national fuels policy. Throughout the speech, the Secretary slides in references to "efficiency" in fuel utilization, maintaining the health of all fuels, and to the need eventually for all of the energy sources this country can develop.

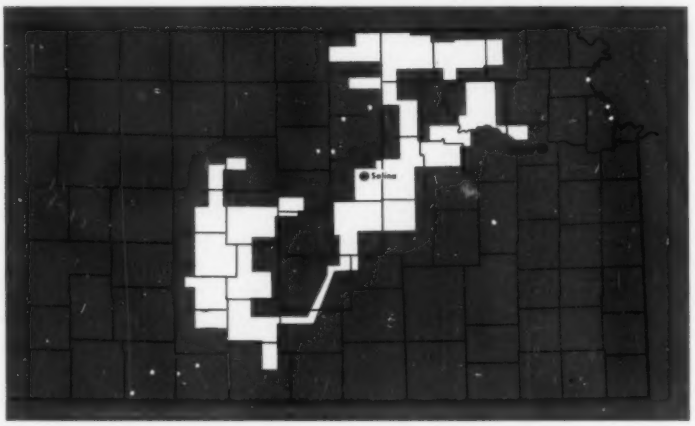
The Seaton speech had some effect on the industry. Washington gas industry spokesmen say there was an immediate press from home offices to get a new drive underway regardless of the politics. However, this first flush soon slowed to a more realistic appraisal of the chances and the beginnings of a slow drive aimed at pushing legislation through in 1961 or even later.

One bright effect of the Seaton speech — the discouragement and disappointment among the gas bill's backers at all the past failures was considerably lessened.

There are some other factors which tend to make cautious optimism for 1961 or 1962 justified. Not the least of these is the continued fumbling of the FPC in trying to administer its unwanted controls. This sad fact becomes more and more clear: There is now no basis for setting a reasonable

Continued on page 93

In Kansas...they save up to 40% on service replacements



The Kansas Power and Light Company cuts labor and material costs with tubing of Tenite Butyrate

The Kansas Power and Light Company serves natural gas to more than 100 communities in the Sunflower State. Faced with an increasing number of service replacements and a rising cost per installation, this utility began to evaluate plastic service replacements in 1956.

The plastic they chose was Tenite Butyrate—the first choice of major natural gas distributors throughout the country, according to a recent survey by GAS Magazine. Butyrate tubing has won this favored position because it offers many advantages.

One of the most important advantages of the tubing is its flexibility, which makes it easy to insert through old metal lines and saves costly re-trenching. And the smaller diameter of the inserted tubing does not reduce flow since its extremely smooth walls permit greater flow under the same pressure than does metal pipe of the same size. Its availability in coils from pipe extruders also helps to simplify storing, transporting, and handling. *(An American Gas Association report recommends that only Butyrate tubing may be coiled for shipment.)*

The Kansas Power and Light Company found that in services of 70 ft. or more, they could save approximately 40% in total installed cost using Butyrate replacements rather than metal. The economy did not stop with installation, however. Virtually non-corrodible, and an excellent dielectric, tubing of Tenite Butyrate cut maintenance to a minimum.

Since 1943, tubing of Tenite Butyrate has been widely used in the gas industry, for service replacements as well as for new services. Moreover, some gas utilities have installed *mains* of extruded Butyrate pipe.

Discover how you can share in the benefits offered by this Eastman plastic. We will gladly send you a list of manufacturers of extruded Butyrate tubing and pipe. Write: EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENN.

A 16mm. sound-color film, "Plastic Pipelines," is available upon request.

TENITE
BUTYRATE
an Eastman plastic

By MARSHALL E. PARKER

Pipe-to-soil potential—3

ONE of the things that makes it difficult to interpret pipe-to-soil potential readings on pipelines is that the reading tries, simultaneously, to give us two separate and different kinds of information. One is what may be termed an *electrode potential*, which is an indication of how the pipe metal is behaving in the electrolyte at the time and place of the reading. Such an interpretation is entirely valid when we are dealing with a small isolated bit of metal; it is often, *but not always*, valid when we are dealing with a long pipeline. This is the type of interpretation we are using when we say that a pipeline is fully protected at a potential of 0.85 v negative with respect to a standard copper/copper sulfate electrode. It is also the interpretation we are using when we employ the "break" in the potential vs log current curve in determining the current requirement for the cathodic protection of well casing.

The other kind of information we get from pipe-to-soil potential readings is that concerning potential differences along the surface of the earth. These differences are detected by comparing two or more values, each of which is an ordinary pipe-to-soil measurement (but actually they could be taken with respect to *any* stable reference, since we are interested only in the differences). This effect is used in the investigation of corroding or anodic areas on bare lines, and in various interference tests. It is this effect we are using when we interpret the high negative potentials along a bare line as being indicative of anodic areas—although we also interpret still higher negative potentials as being indicative of protection!

Unfortunately, we are seldom able to get either one of these effects purely and simply; there is almost always some of both present. The electrode is always separated by some distance from the surface of the pipeline. So there is always the chance of an IR drop, due either to the protective current we are studying or to some extraneous current, being superimposed on the potential we are trying to measure. If the line is bare, there is seldom any trouble with this phenomenon. But when the line is coated, the effective electrical center of the line may be many miles from the point of observation, and even small extraneous currents can produce IR drops of very considerable magnitude. It is for this reason that the fluctuations in potential—or rather in apparent potential—are much greater at or near the ends of a coated line than in central positions.

A similar phenomenon frequently leads to confusion in interference studies. The important thing to discover in an interference study is whether or not the "foreign" structure is actually discharging current to earth. Sometimes we discover this by inference; that is, we find that it is collecting current, and, if we know that there is no metallic path for the return of this current, then it must be discharging it somewhere. When the source of the current suspected of interference is nearby —as when the foreign structure passes close to a ground bed—then it is extremely important that the electrode position be correct. In the vicinity of a ground bed, the potential gradients are steep; any two contacts with the earth placed along the gradient, or in any direction except at right angles to it, are bound to show a difference in potential which does not necessarily mean anything but current flow in the earth. If one of these contacts is the foreign structure and the other one is the electrode, then the indicated potential may simply be the effect of current flowing from the anode *by* the structure. To avoid this error, the electrode should be placed as near the structure as possible, and at right angles to the direction of potential gradient. Another and more positive method is to map the potentials all around the structure. If the gradient is not distorted by the structure, then there is no interference. A still more positive method, although not always applicable, is that of measuring line currents in the structure itself.

The mapping of potential gradients over an area can serve other purposes. It is an excellent way to study the protection of a connected network of piping, as in a plant. Since there is never any large difference in potential between two points on the connected piping itself, it is necessary only to make a limited number of connections to the piping. The electrode is then moved about, usually following a rectangular grid, until sufficient readings are accumulated to draw a "contour" or equipotential map. From such a map it is easy to see where additional anodes or rectifiers are needed to improve the protection.

The same technique is useful in investigating ground beds or galvanic anode groups where loss of current output has been experienced. From the contours, it is easy to see if any anodes are disconnected or inactive; it is also easy to locate all which are working normally.

Many questions concerning the potentials accompanying certain

Continued on page 92

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Your local IBM representative will explain the many applications and unusual features of the new 1401 Systems. Call him today. These systems, like all IBM data processing systems, may be purchased or leased.

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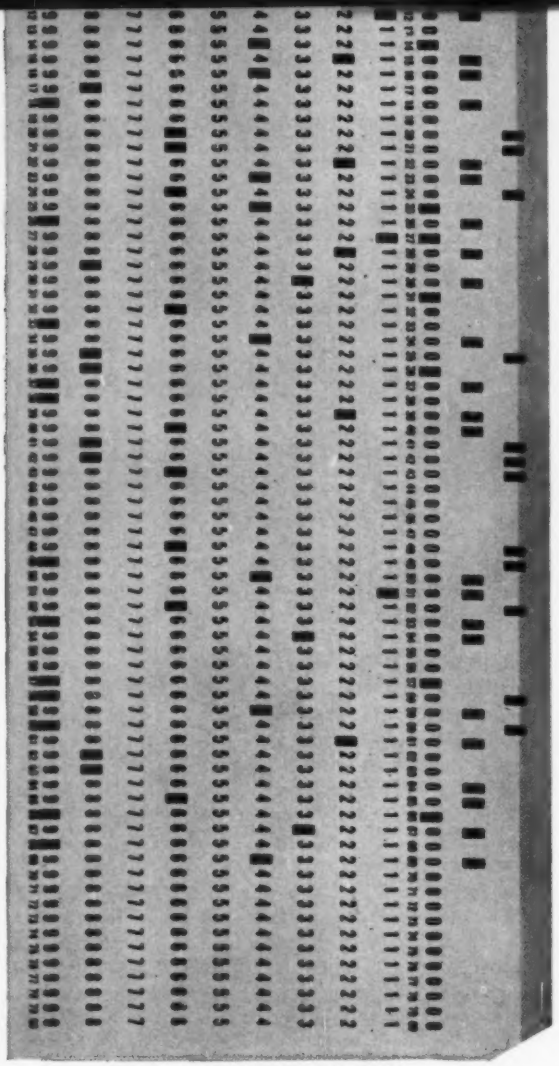

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These stored program systems now bring the power of electronics to IBM card systems. They automatically handle the work of accounting machine, summary punch, and calculator, but at far greater speed, and with more flexibility and accuracy.

Input is faster—IBM cards are read into the system at the rate of 800 per minute. Data is processed automatically under stored-program control. Manual card handling is minimized.

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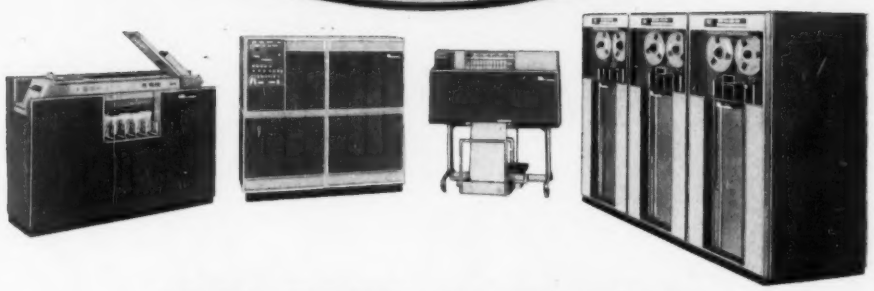

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IBM 1401 Tape Systems give you added power through use of up to six magnetic tape units. These units feed data into the system at the rate of up to 62,500 characters per second . . . record processed results at this same peak speed.

1401 Tape Systems are also extremely valuable as off-line auxiliaries to large data processing systems. They can edit tapes prepared for larger IBM systems. They make possible a tape-oriented IBM 7070 configuration that provides higher speed input and output and makes for job cost improvement.

When tape units are added to 1401 Systems, you get greater flexibility and storage advantages, too. IBM tapes provide extremely compact storage of variable-length records—the equivalent of 129,000 IBM cards on a single reel. Tape records can be of variable length, and are read into and out of the system automatically. Also, tapes can be erased and re-used to minimize your record-keeping costs.

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. . . Many of our modern conveniences will be gone by the next century. But there is one thing you can count on: the cast iron pipe you install today will still be in good operating condition in 2059.

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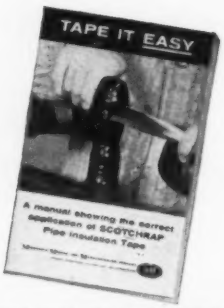
This controlled test was designed to measure the resistances of various coatings to backfilling and soil stresses. It clearly demonstrates the superior abrasion and puncture resistance and excellent bond strength you get *only* with "SCOTCHRAP"—the toughest polyvinyl chloride plastic tape. These properties are so superior that with normal care, no protective overwrap is needed. Add the excellent electric properties, and you have the reasons why we believe "SCOTCHRAP" is the best total coating buy you can make.



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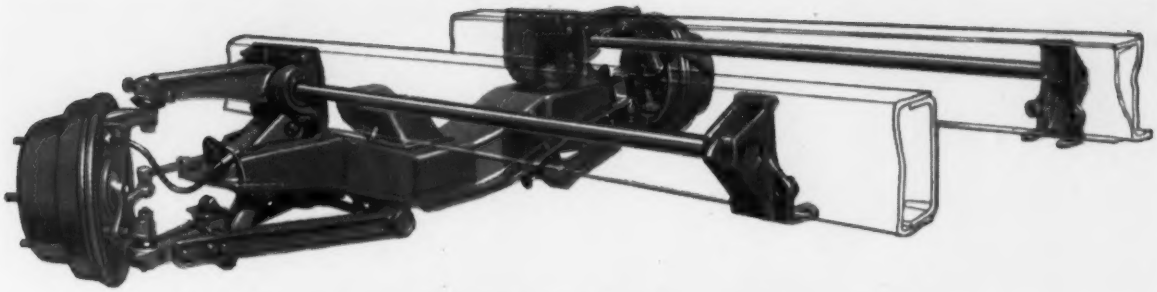
SCOTCHRAP BRAND Pipe Protection Products

The term "SCOTCHRAP" is a registered trademark of Minnesota Mining and Mfg. Co., St. Paul 6, Minn. Export Sales Office: 99 Park Avenue, New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

MINNESOTA MINING AND MANUFACTURING COMPANY
...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY



CHEVROLET'S REVOLUTIONARY TORSION-SPRING RIDE

the most significant new truck development in decades!

Years of intensive engineering achieved a revolutionary result—a totally new truck suspension system. The most exhaustive chassis engineering program in trucking history proved conclusively that, from the standpoints of both ride and durability, the finest possible truck suspension system would consist of independently suspended front wheels with torsion bar springing. Advancing on this principle, Chevrolet engineers proceeded through years of development to produce a completely new system for the 1960 Chevrolet truck product.

New Torsion-Spring Ride—how it works. The revolutionary result of Chevy's all-out engineering effort—Torsion-Spring Ride—eliminates both the old-fashioned I-beam front axle and friction-producing front leaf springs. Each front wheel, suspended independently of the other through tough control arms and low-friction linkage, is free to step cleanly over bumps without jarring the entire truck. Also, friction-free torsion bars on either side of the chassis, specially mounted to provide a twisting action, work to absorb each jolt; they flex freely to soak up all kinds of shocks, from the smallest to the most severe.

Three new rear suspensions, tough and tailored to the truck, are completely redesigned to complement the independent front suspension in every weight class.

M70 tandem proves its stamina on year-long test of durability.

Here's a ride that lets you get more work done in a day's time! Take a '60 Chevrolet truck over a rough stretch of back road and feel the absence of I-beam shimmy and wheel fight. Chevy's torsion springs soak up jolts and jars that would shake the headlights off an ordinary I-beam rig. You move along with maximum payloads at higher safe cruising speeds. You make your tough off-the-highway runs in less time, improving your ton-mile-per-hour rate as much as 100%.

A ride that shows respect for the driver and the load! Out at the GM Proving Ground, the test drivers will take a torsion-spring Chevy any day over an I-beam truck—even if they have to drive it twice as far. The ride's that much better; that much safer. The load, too, has an easier time of it. There's far less bounce and jounce, less danger of damaging fragile cargoes.

A ride that adds extra thousands of miles to the truck's working life! You can be sure the shockproof action of Chevrolet torsion-spring ride means lower maintenance costs. As much as 78% of all objectionable road shock and vibration is absorbed before it can be transmitted to the truck's body and sheet metal. Chevy trucks stay new-looking a whole lot longer and their working life is increased by extra thousands of miles.

Once you've experienced the incredible smoothness of a torsion-spring ride, you'll realize that Chevrolet has set off a full-scale revolution with the introduction of its '60 models. By throwing away the old-fashioned I-beam in favor of independent front suspension, Chevy's new design has improved virtually all phases of truck performance. Drive a new one just once. That's all we ask. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

1960 CHEVROLET STURDI-BILT TRUCKS

CHEVROLET

ARC-WELDING ATTACHES RISERS after acetylene torch has cut necessary tie-in holes.

"...X-TRU-COAT will save this city

THREE-INCH X-TRU-COAT CONNECTS OLIVE HILL system to main pipeline two miles away. Two-inch lines take off from this substation and run up tree lawns of the various streets.

Contractor Richard Short tells how plastic-coated pipe solved Olive Hill, Kentucky's soil problem

"Kentucky soil is death on ordinary pipe," says Mr. Richard Short, contractor who handled installation of a new, 60,000-foot natural gas system* at Olive Hill, Kentucky. "In our part of the state particularly, soil is extremely corrosive.

"It's my business to know the materials we use. We selected X-TRU-COAT because it's downright immune to the acids and chemicals that are our problem. The polyethylene coating on this pipe doesn't absorb water. It protects against electrolytic action, too. The metal is completely insulated by the plastic.

"Republic meant for that coating to stay on. We needed an ax or mattock to peel it off when tapping

READY FOR INSTALLATION, part of the 60,000 feet of one- two- and three-inch X-TRU-COAT Plastic-Coated Steel Pipe and Tubing for Olive Hill is unloaded at railroad siding by crane.

FROM TREE LAWNS TO HOUSES, installation called for one-inch X-TRU-COAT with riser and right angle weld. Shut-off valves were attached before line entered residences.

thousands of dollars!"

in any place but at the ends of a length. Yet the same coating is really flexible. We never experienced damaged coating as a result of bending.

"This is the only pipe I know of that can do a job for Olive Hill," says Mr. Short. "By eliminating corroded service and distribution lines, X-TRU-COAT will save this city thousands of dollars!"

• • •

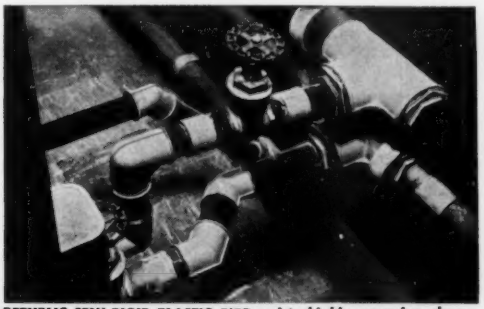
Learn more about the pipe that combines the strength of steel with the protection of high-density polyethylene plastic. Delivered ready for installation, X-TRU-COAT is available in a wide range of pipe and tubing wall thicknesses and diameters (through 5⁹⁄₁₆" O.D.). Get the complete story. Contact your local Republic sales office or mail the coupon.

**Distribution system designed by the firm of J. Steven Watkins, Consulting Engineers, Lexington, Kentucky.*

REPUBLIC STEEL

CLEVELAND 1, OHIO

World's Widest Range of Standard Steels and Steel Products



REPUBLIC SEMI-RIGID PLASTIC PIPE resists highly corrosive chemicals, prevents scale build-up, yet costs no more than ordinary pipe. SRK is easy to handle and install. Cuts with hand- or hack-saw. Joints are quickly and permanently "welded" with brush-applied solvent and plastic couplers. Send coupon for complete information.

FOR NEW AND REPLACEMENT USE—service entrance lines of Republic SRK are gaining wide acceptance. Corrosion-resistant SRK saves time and money in new connections through its low initial cost and ease of installation. On replacement jobs, SRK is threaded through existing line from tap to riser, eliminating costly trenching.

REPUBLIC CONTINUOUS BUTT WELD PIPE is known for excellent in-service dependability. Tight galvanized coating resists corrosion. Uniform ductility and strength assure easy workability, fine threading characteristics. Available in economical double-random lengths. Mail coupon for further information.

REPUBLIC STEEL CORPORATION
DEPT. G5-7476-AR
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Send more information on:

☐ X-TRU-COAT Plastic-Coated Steel Pipe and Tubing
☐ Semi-Rigid Plastic Pipe ☐ Continuous Butt Weld Pipe

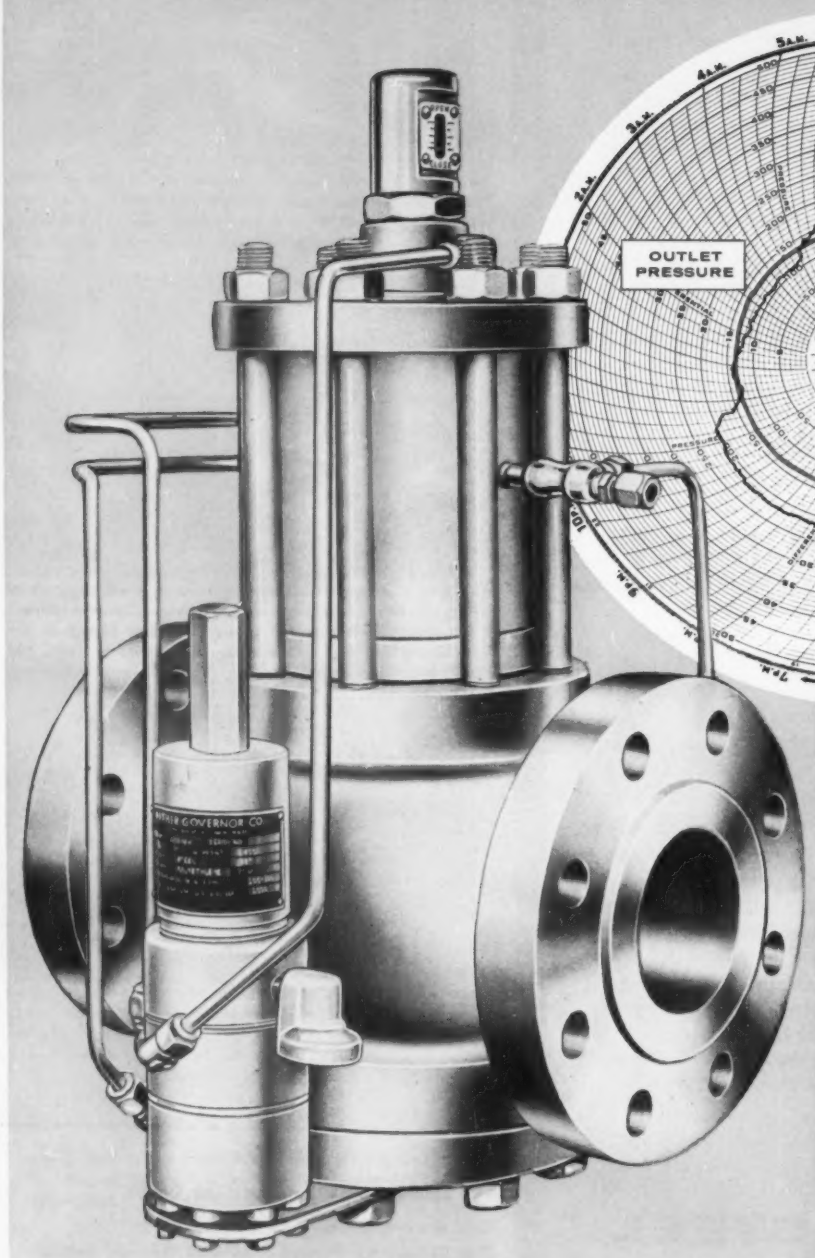
Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

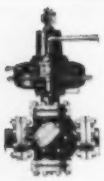
FISHER Type 403



Here's An Actual Performance Chart of the 403

Shown above is a 24-hour recording of changing gas demand and simultaneous performance of a 4-inch Fisher Type 403 Gas Regulator. This chart was made in a large midwest town border station.

Controlled flow ranges of 1½ to 3 million SCFH were charted. Inlet pressure was 350 to 750 PSI—outlet pressure 140 PSI.



IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

a revolutionary approach to high pressure gas regulation

- **Unusually Stable**
- **Exceptionally Accurate**
- **Positive Tight Shut-off**
- **Wide Rangeability**
- **Small and Compact**
- **No Atmospheric Bleed**

The Fisher Type 403 is designed to solve the gas man's problems of maintaining uniform downstream pressure, regardless of extremes in differential pressure, on any high pressure line such as town border or compressor stations.

The chart to the left shows a complete absence of cycling or hunting even under a wide range of load demand.

Unusual stable control under all flow conditions is possible because the Type 403 inner valve is positioned by a piston which makes full use of inlet pressure to balance the inner valve. Full inlet pressure can be applied to the downstream side without danger of damage or overstress.

The Type 403 shuts off dead tight with very little build-up in the downstream pressure even with pressure drops up to 1000 PSI. Can be easily disassembled and assembled in less than half an hour without removing body from the line.

Write for Bulletin P-403.

Body Specifications

Body Sizes—1" and 2" Screwed; 1", 2", 4" and 6", 150 to 600 lb. ASA Flanged. Single port only.

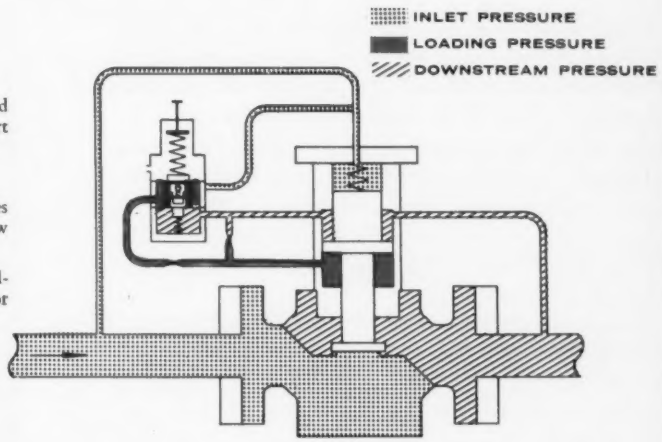
Body Material—WCB cast steel.

Valve Disc Material—Polyethylene for pressures above 150 PSI. Neoprene for pressures below 150 PSI.

Body Trim—316 stainless steel. Stellite seat available for extremely high pressure drop or erosive conditions.

Maximum Inlet Pressure—1000 PSI.

Maximum Outlet Pressure—450 PSI.



FISHER® Controls

SINCE 1880

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIP. CO., CORAOPOLIS, PA.

THE U.S. TREASURY SALUTES THE PETROLEUM INDUSTRY

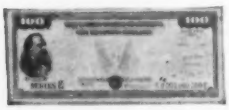
—and its thousands of employees who help strengthen America's Peace Power by buying U.S. Savings Bonds

People in America's petroleum industry take pride in the vital role of their products and services in the national defense and domestic economy. This year the petroleum industry celebrates its first century and features the slogan "Born in freedom . . . working for progress."

Thousands upon thousands of these people find personal satisfaction, too, in helping to strengthen America's Peace Power through regular purchase of U.S. Savings Bonds. The use of the Payroll Savings Plan makes this sound practice convenient and easy.

If your own company does not have a Payroll Savings Plan in operation at present, take one of these two easy steps to start one and help your people to "Share in America." Your State Savings Bond Director is anxious to help. Telephone him now. Or write to Savings Bond Division, U.S. Treasury Department, Washington, D. C.

L. P. HOLLAND, skilled refinery technician, is typical of thousands of key employees in this field who are buying U.S. Savings Bonds regularly. Mr. Holland, through his company Payroll Savings Plan, is making a personal contribution to the Peace Power of our country.

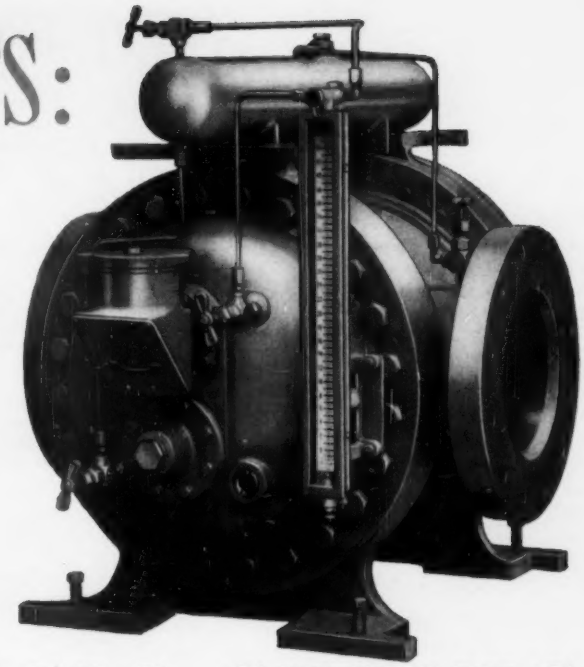


GAS MAGAZINE

THE U. S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTISM, THE ADVERTISING COUNCIL AND THE DONOR ABOVE.

R-C PRESENTS:

a new line of high-pressure rotary gas meters



FOR 600 PSIG SERVICE

A new line of 600 psig rotary positive displacement gas meters has been developed by Roots-Connersville to serve the needs of industries requiring extreme measurement accuracy in the higher pressure ranges. The meters are available in 4 sizes covering a range of from 84,000 to 1,600,000 scfh.

THIS NEW METER LINE IS IDEAL FOR MANY APPLICATIONS:

- City Gate Metering
- Transmission Line Metering
- Process Gas Metering
- Chemical Gas Manufacturing
- Gas Lifting
- Compressor Stations
- Well Head Measurements
- Steel Mills
- Underground Storage
- Metering of pulsating flow and surges, H2, 02, C02, NH3, LP gas, NO, He, C2H2, etc.

R-C rotary gas meters require an absolute minimum of maintenance . . . assure almost complete freedom from wear . . . exceptionally high accuracy in metering. A refinement of the basic R-C rotary-positive design which has proved its dependability over the years. These new meters for 600 psig service have incorporated simple in-the-line mounting, straight through flow . . . high-speed gears . . . and a welded steel outer case enclosing a steel inner cylinder. Throughout their extra wide operating range, these new R-C meters assure greater accuracy and improved performance in handling a wide variety of gases.

The development of this new meter is another example of R-C's specialized experience of more than 100 years in the design and application of air and gas handling equipment.

Write us for additional information and data sheets about these new Roots-Connersville meters for 600 psig service.

ROOTS-CONNERSVILLE BLOWER
DIVISION OF DRESSER INDUSTRIES, INC.
1259 Oregon Ave., Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto

COOKING IN THE FIREPLACE was romantic but hardly efficient. Heat was slow, uneven, uncontrollable . . . iron pots and pans, heavy. Feeding the family was work!

BASIC . . . but better than ever today

GAS "BURNERS WITH BRAINS" in today's kitchen . . . most recent achievement of the gas industry . . . "feel" and control heat in pots and pans . . . make cooking automatic . . . a pleasure!

Throughout the nation the cast iron gas mains of 55 major utilities are still serving after over a century of profitable operation. Cast iron pipe's quality is no accident. In our case, we assure it by controlling every production step. From mine to finished product, every length of pipe is subjected to exacting tests. This added care along our line contributes to smooth, trouble-free performance in yours.

You can depend on U. S. Pipe. Its performance is built-in.

SERVICE IS BUILT INTO CAST IRON

- Standardized mechanical joints are bottle-tight for usual gas distribution pressures . . . and for all types of gas.
- Centrifugally cast pipe is tough, strong and uniform.
- Joint design allows for deflection during and after installation.
- Service connections are easily made.
- Long life a matter of record.
- No shortages. Cast Iron pipe is immediately available.

U.S. cast iron PIPE

CAST IRON

U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

GEM Sponsor

A WHOLLY INTEGRATED PRODUCER
FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

Now

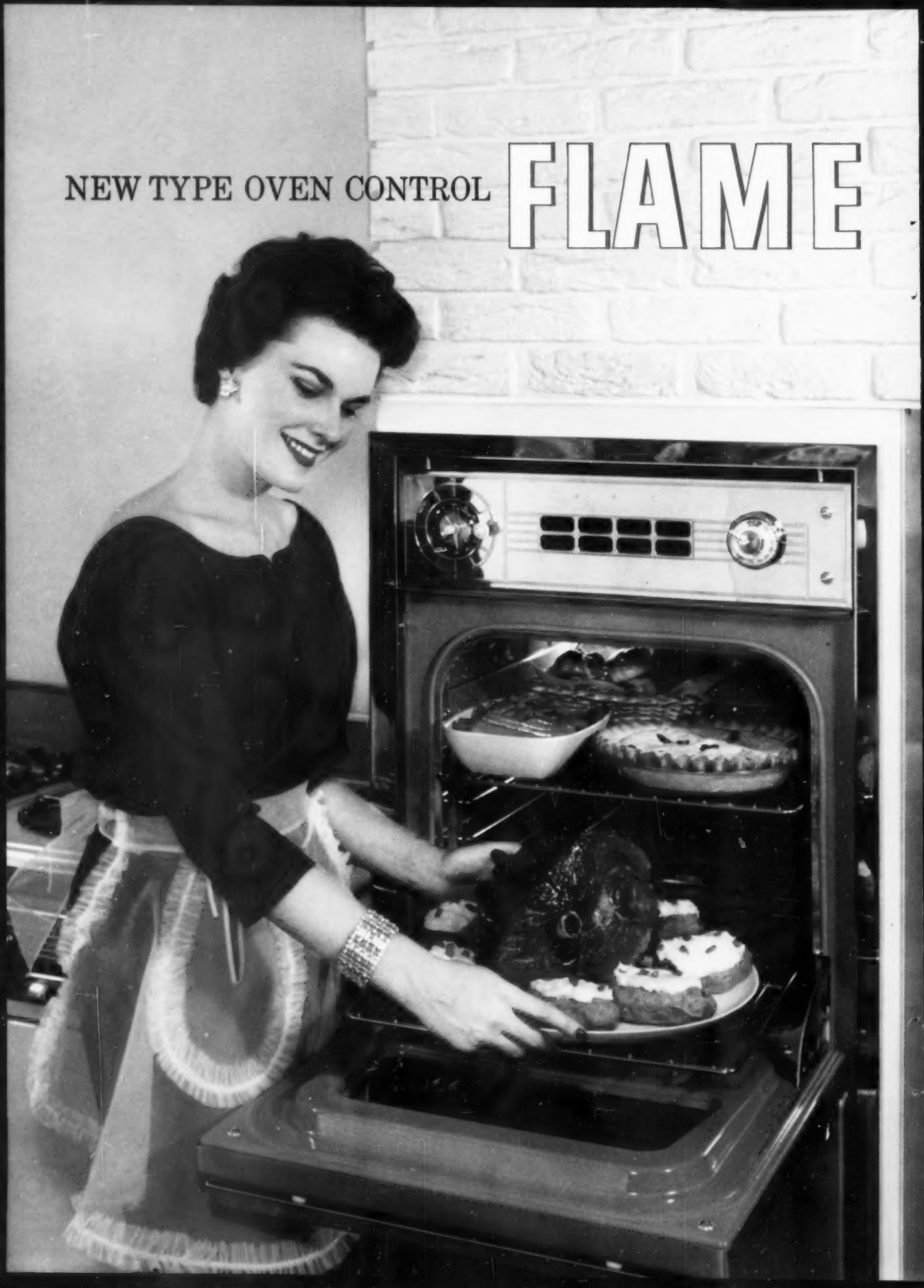
accurate oven control down to 140°

Biggest advance since the "burner with a brain"*

*A. G. A. Mark

NEW TYPE OVEN CONTROL

FLAME



MASTER

NOW, a roast, even the entire
can be cooked ready-to-serv
...hours before serving tim

No drying out... No w-i-d-e temperature

NOW, the homemaker can complete cooking... hours before serving time. She can delay serving for hours... warm dishes... and thaw frozen foods in her new gas oven!

She can enjoy all these advantages by simply turning the new FLAME MASTER* gas oven control dial to the LO-TEMP area... down to 140°!

This new FLAME MASTER oven control will convert "lookers" into buyers and here's why — this biggest advance since the "burner with a brain" will soon be the *most-wanted* feature in new ranges and built-ins.

No w-i-d-e temperature swings. Of all oven controls, only the FLAME MASTER *accurately* controls temperatures from 550°
able only in gas ranges, it's
than can't be duplicated.

The new "no-button" au
a part of this FLAME MASTER
gives you another sales clinc
out for any reason, the hom
a lighted match to it! There
and hold in, no string to p
service man.

Write today for literatu
be asking about the FLAM
gas oven control with *accur*
Robertshaw Thermostat D
Fulton Controls Company,

Reprints of this ad will soon be mailed to leading gas appliance dealers

Robertsha

e meal
rve
me!

ure swings

550° *down to 140°*! Avail-
it's a Robertshaw feature
d.

' automatic oven pilot,
STER oven control system,
clincher. If the pilot goes
homemaker simply holds
There's no button to push
to pull, no waiting for a

ature. Homemakers will
FLAME MASTER—the new
ccurate LO-TEMP settings!
at Division, Robertshaw-
any, Youngwood, Pa.

VMA 6782

*Trade Mark

aw ® MR. CONTROLS

Showers

Dresses

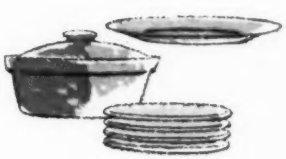
Relaxes with
Her Family

Entertains
Her Guests

Since the completely cooked roast and the entire dinner can be held for hours at serving temperature, the homemaker is no longer ruled by the kitchen clock.

Ready-to-Serve Meals Can Be
Delayed . . . for Hours

Now, that the ready-to-serve roast and dinner can be delayed for hours, there's no cause for worry if father or guests are late!



Warm
Dishes

Thaw
Frozen Foods

And now the homemaker can use her gas oven for warming dishes and for faster thawing of frozen foods. Example: a 7-lb. turkey can be thawed in about 2½ hours vs. 28 hours in a refrigerator or 14 hours at room temperature!

Here's the
new type
oven control
that will...

convert "lookers" into buyers!

A MANUAL ON THE USE OF

Plastic Pipe and Fittings

in the Natural Gas Industry

64 PAGES 50¢

This manual provides a wealth of background information invaluable to gas distribution men responsible for plastics pipe applications.

It traces the development and progress of plastics piping in the gas industry, details the properties and performance of these piping materials in gas systems, and describes both routine and unique applications gas companies are making of plastics.

GAS • *THE NATION'S NATURAL GAS AUTHORITY*
Dept. G • 198 S. Alvarado St., Los Angeles 57, Calif.

Send me ..... copies of Plastic Pipe and Fittings. Payment enclosed.

NAME .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

POWERS American

SERIES LM-4

"Load-Master"

HYDRAULIC CRANE

Saves time and manpower because it speeds up loading and unloading jobs... handles work normally requiring several specially-equipped vehicles.

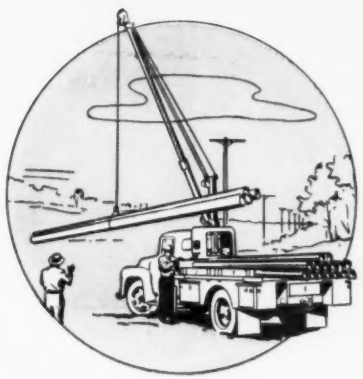
Load-Master lifts a 4000 lb. load with ease... moves it safely and quickly under the most adverse job conditions. Power is derived from a heavy-duty hydraulic pump driven by the truck engine. Controls are located in a position which gives operator full view of the crane at all times.

Operator has absolute control of load at all times. The hydraulic system requires intentional movement of control levers before load position can be changed... and the load cannot drop if the truck engine stalls.

OPERATING FEATURES: Telescopic-type hydraulic boom can be spotted at any point from horizontal position to an 85° angle of elevation; hydraulically-powered mast will turn 360° in either direction; specially-designed winch, driven by a hydraulic motor, is grooved to wind cable evenly; hydraulic outriggers, with swivel-mounted foot plates, furnish extra side stability.

Load-Master is ideally suited for use with the Powers-American Series 300 Body shown above. It can also be furnished with bodies of other types... or shipped for mounting in your shop or local garage.

Price information and descriptive literature will be sent upon request.



Load-Master requires only 20" of mounting space behind truck cab. Boom extensions to 22' can be furnished.

McCABE-POWERS BODY COMPANY

5900 NO. BROADWAY, ST. LOUIS 15, MO. | 625 CEDAR STREET, BERKELEY 10, CALIF. | 5525 S. E. 28TH AVE., PORTLAND 2, ORE.

THE ANSWER TO CONNECTION PROBLEMS

BRANCH CONNECTIONS

MADE UNDER PRESSURE

The best and most economical method of making lateral or branch connections is to use Smith All Mechanical Joint Tapping Sleeves and Valves or Stopper Pieces. This method ELIMINATES GAS SHUT OFF and the permanent, leak-proof installation is achieved speedily by employing these simple procedures: 1. Block Sleeve Outlet Half under pipe, position side flange gaskets, bolt Sleeve halves together. 2. Position end joint gaskets; install follower rings, bolts and nuts. 3. Rotate Sleeve outlet flange to desired position, tighten follower ring nuts. 4. Tighten side flange gasket compression screws. 5. Attach Tapping Valve. The installation is complete and ready for tapping. 5. (Alternate) Stopper Pieces may be used in place of Valves when connections are made to low pressure mains and permanent shut off Valves are not needed; however, the use of Tapping Valves is recommended. The cost of the connection is reduced by quicker installation, elimination of skilled labor and costly jointing material. Bulletin will be sent on request.

51

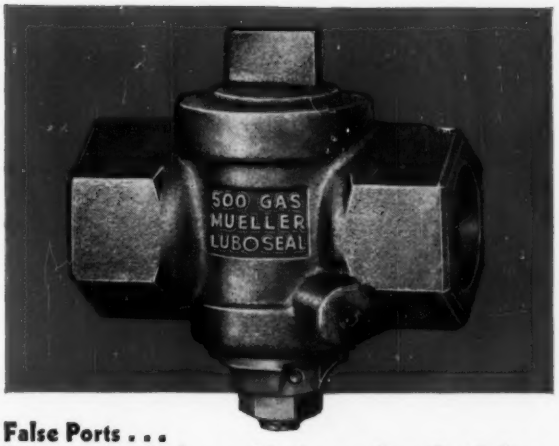
FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

NEW MUELLER® 500 pound LubOseal stop/ductile iron

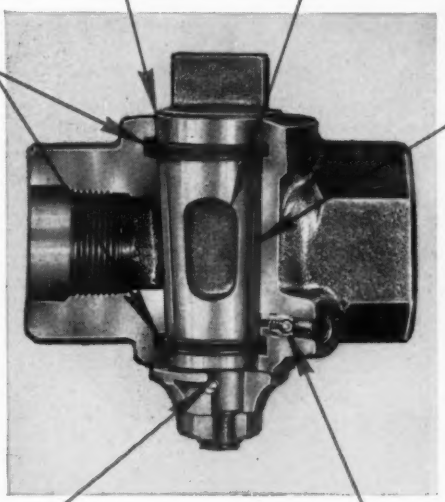
...ground key surfaces and "quad-rings" provide pressure seal



False Ports . . .
False ports in the key and body are aligned with the true ports in the body and key when the stop is in the closed position. This prevents grit or dust in the gas from settling upon the polished sealing surfaces and later damaging them when the key is turned to open the stop. Seating contact is reduced to only those areas where it is useful, resulting in an easier turning stop.

Ground and Lapped Body and Key . . .
Ductile iron has excellent machining qualities, therefore the body and key can be accurately machined and **individually** ground and lapped for a precision, gas-tight fit.

Quad-Ring Seals . . .
Top and bottom of the key are positively sealed by quad-rings located in annular grooves in the stop body. The quad-rings also pressurize the lubricant — deflecting as the lubricant reservoir is filled and expanding to keep pressure on the lubricant as it is used.



Lubricated Key For Easy Turning and Pressure Tightness . . .
The lubrication system of LubOseal Stops maintains a proper grease film on the seating surfaces, assuring easy turning and pressure tightness. Four vertical grooves in the key distribute the lubricant over the ground and lapped surfaces each time the stop is operated. The quad-rings in the circular grooves and the entire seating surface between these grooves are fully lubricated. In any position other than fully "opened" or fully "closed", the vertical grooves are disconnected from the circular reservoir grooves, preventing the line pressure from forcing the grease out of the lubricant system.

Ductile Iron Body and Key . . .
The corrosion resistance of cast iron with the strength, impact and fatigue resistance of steel — all these advantages are incorporated in the 500 pound LubOseal Ductile Iron Stop. The body threads are recessed for extra strength and rigidity. Body ports are tapered to meet the straight way in the key, providing smooth flow and additional strength.

Tamper-Proof . . .
A heavy bronze washer is secured to the lower end of the key by a drive-lock pin in a blind hole, thereby permanently maintaining the perfect adjustment between the key and body. Stop is operable with the stem nut removed or with the nut over-tightened to the point of stripping the threads, providing an additional safety feature.

Triple-Sealed Re-Lubricating Port . . .
The grease port is located so that a ground and lapped seating surface is between it and the main gas port, preventing any leakage. A spring loaded, ball-check grease fitting provides a second seal. The socket head pipe plug forces grease through the grease fitting into the entire lubricating system and provides a third and final seal!

H-11180 Solid Head
Sizes: ¾", 1", 1¼", 1½", 2"

H-11185 Lock Wing
Sizes: ¾" and 1"

For complete information and literature write direct to:

GEM

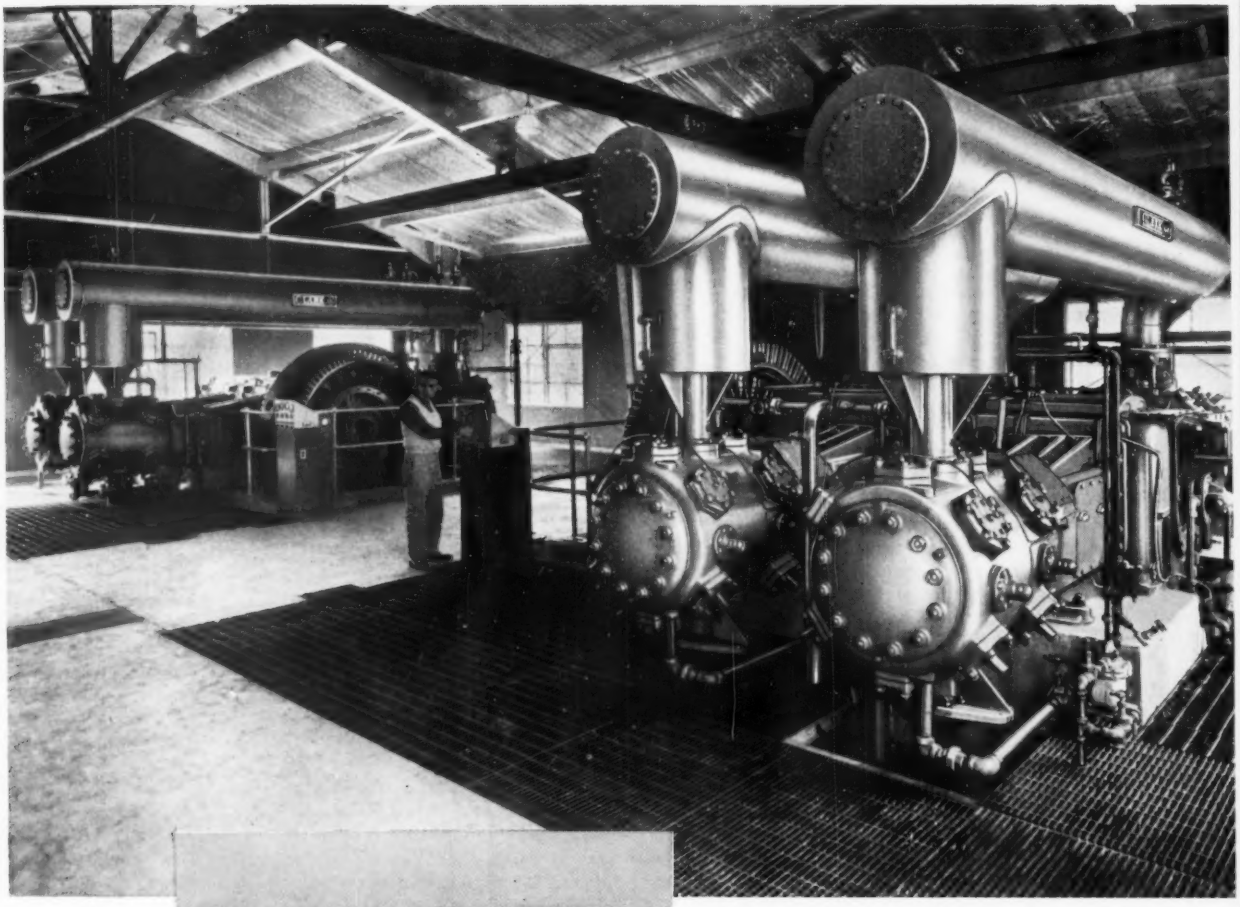
NO-BLO®

MUELLER CO.
DECATUR, ILL.

MUELLER CO. Since 1857 SERVING the Water and Gas Industries QUALITY

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited; Sarnia, Ontario

for PEAK



Clark Model CLRA-4 Balanced/Opposed Compressors are of overhung rotor design. Heavy shaft and crankcase design eliminates the need for troublesome outboard bearings.

The Dicks Creek Gas Plant of Cincinnati Gas & Electric Company, near Cincinnati, Ohio.

SHAVING...

World's Largest High Pressure Gas Plant Goes Into Operation for Cincinnati Gas & Electric

Utilizing man made shale caverns 350 feet below ground level for liquid propane storage, Cincinnati Gas & Electric Co. have assured their customers of an adequate supply of gas during seasonal peak demand periods. Located at Middletown, Ohio, the plant's liquid storage caverns are supplied by a products pipeline which originates in the state of Texas.

The propane, vaporized by steam, is processed and blended with natural gas to achieve a Btu value approximating that of the original natural gas. Daily capacity of the plant is 50 million cubic feet.

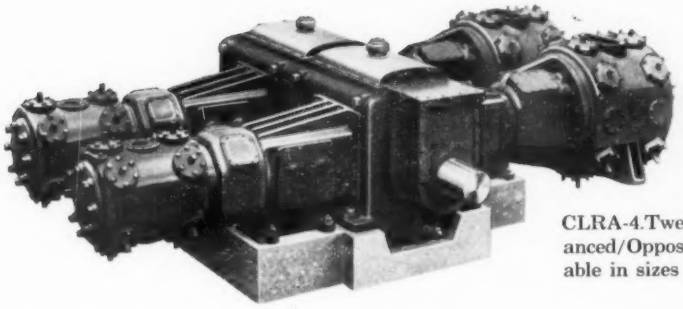
890,000 cfh of air is supplied to the gas plant by two Clark 1750 bhp Balanced/Opposed Motor Driven Compressors at pressures ranging from 150-225 psig.

Whether your gas storage problems involve liquid or gaseous product, Clark has a wide range of compressors and experience to fill your requirements. Write for bulletin 160.

CLARK BROS. CO.
OLEAN, N.Y.
Offices in Principal Cities Throughout the World

CLARK

Engines
Compressors
Gas Turbines



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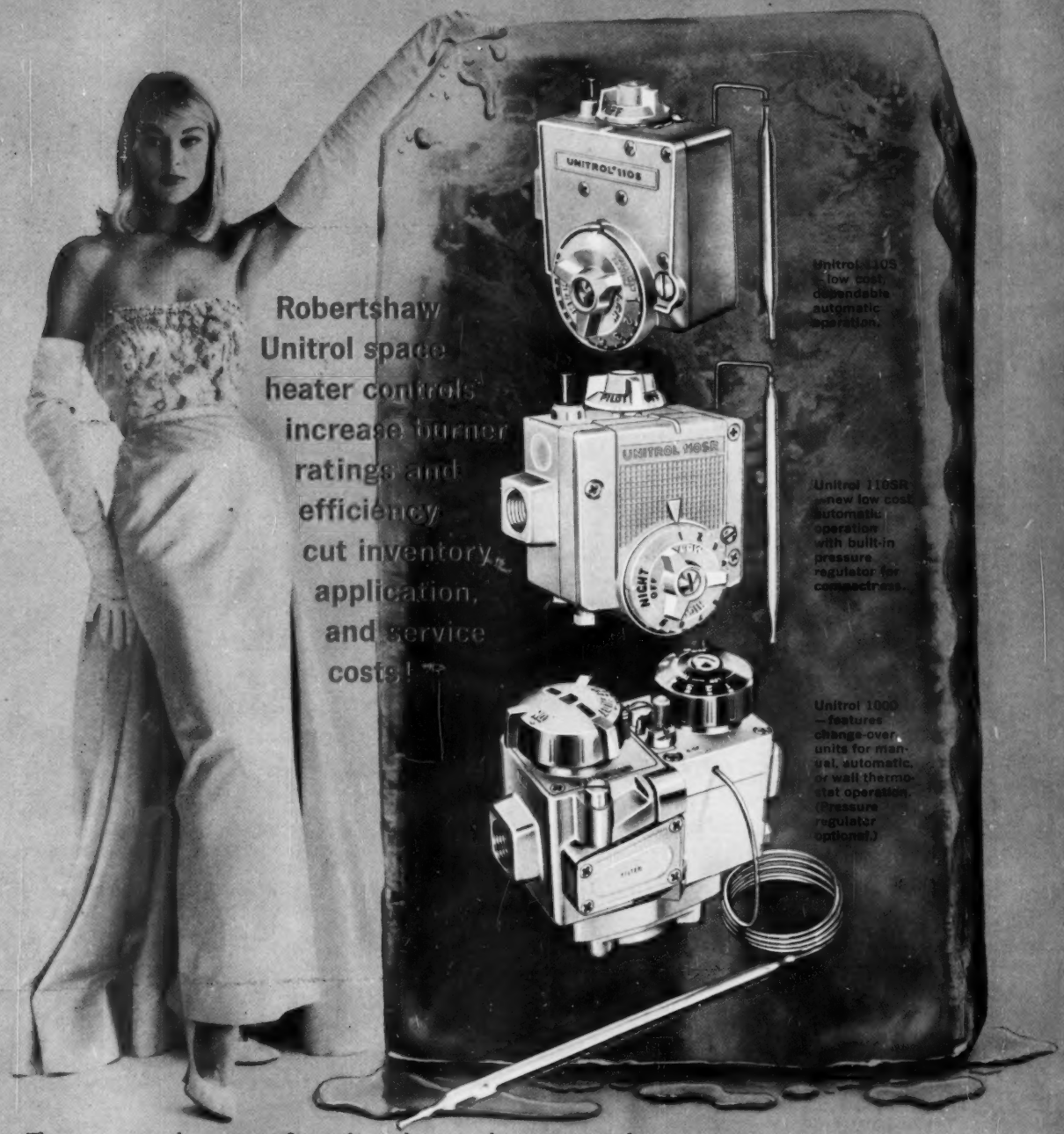

Robertshaw Unitrol space heater controls increase burner ratings and efficiency, cut inventory, application, and service costs!

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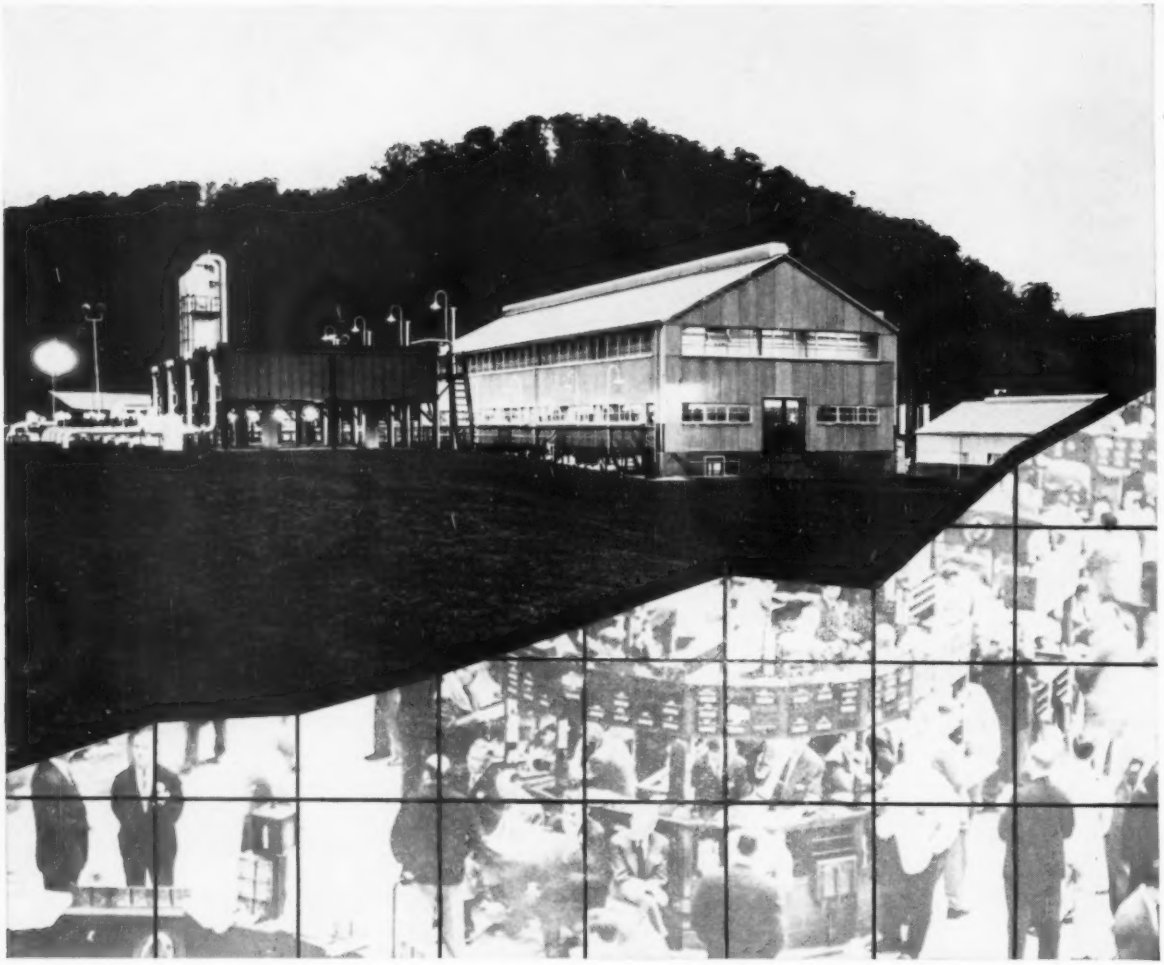

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Through Pritchard's emphasis on good financial design, the Majorsville Station has replaced an older compressor station at a cost permitting a reasonable return on the investment.

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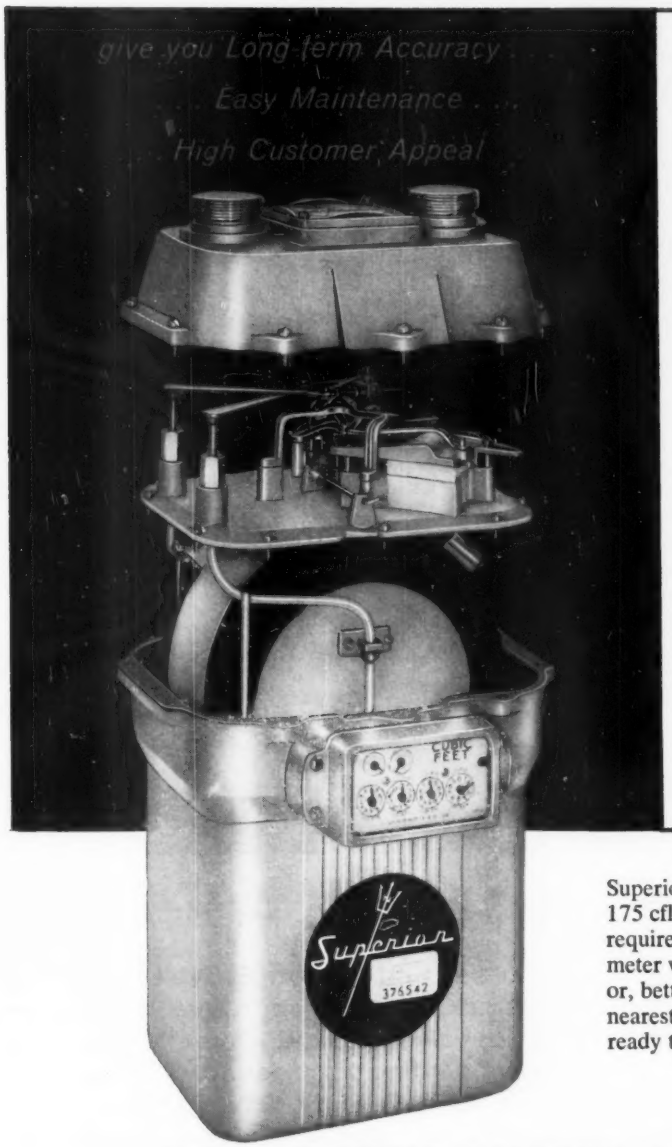

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15

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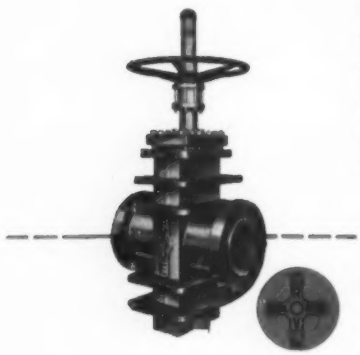

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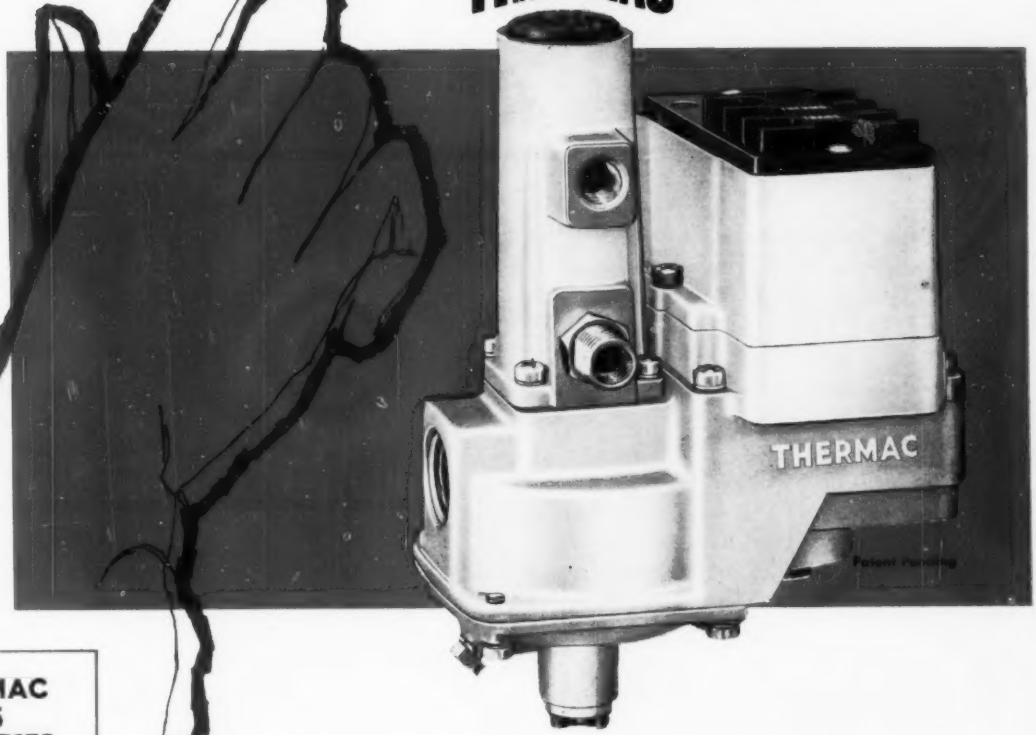

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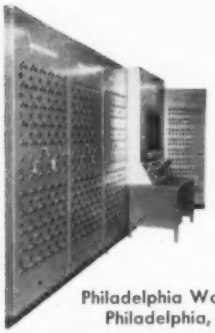
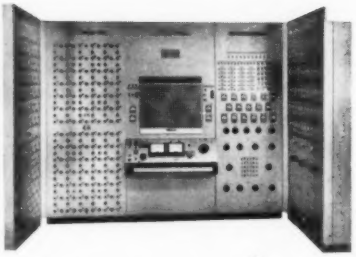


Philadelphia Water Department
Philadelphia, Pennsylvania



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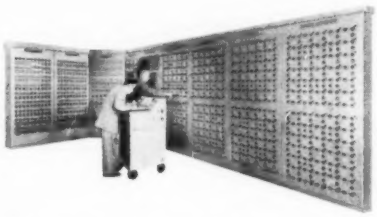

Public Service Electric and Gas Company
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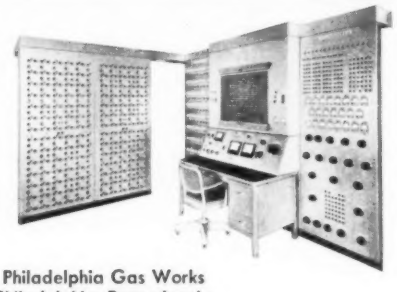

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For information and a complete list of users of the McIlroy Fluid Network Analyzer, write to The Standard Electric Time Company, 89 Logan Street, Springfield 2, Massachusetts.

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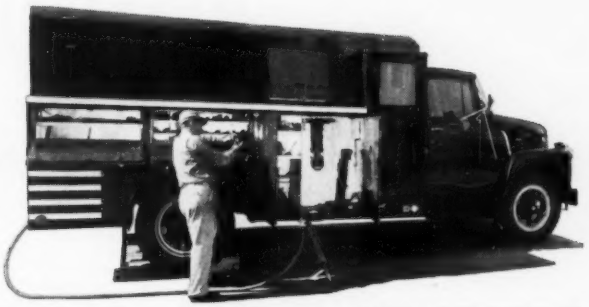

—or Emergency

Emergency or routine—it makes no difference. Men, material—and power—are needed on the job.

The Holan 2236-3 Air Compressor Body with Crew Compartment is designed and built to carry all three to any gas construction or maintenance job.

Built of high tensile steel, this Holan Air Compressor Body can be mounted on any chassis with 102″ CA dimension. The four-man crew compartment is an integral part of the body. The air compressor unit is located in the compartment directly behind the crew compartment.

Holan design leadership and quality construction are found throughout the Air Compressor Body. Compartments for carrying jack hammers, tapping machines, paving breakers, tampers, fittings, rubber goods, gas masks, hose reels, pipe, ladders—everything needed on the job—are conveniently located in this rugged body.

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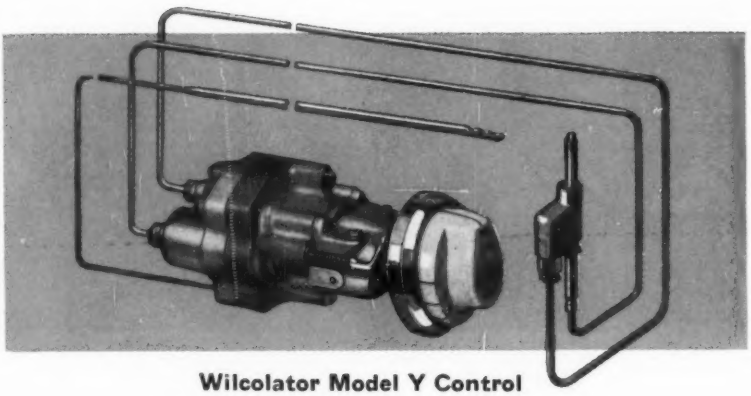

Wilcolator Model Y Control

Temperature range:
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AGA rating, Btu/hr:
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Natural gas—63,700
LP gas—136,000

The Wilcolator Model Y thermostat is a high-capacity unit delivering top efficiency as a gas valve, automatic pilot, oven temperature control, and pilot filter. Its advantages (shown above) add up to dollars-and-cents savings.

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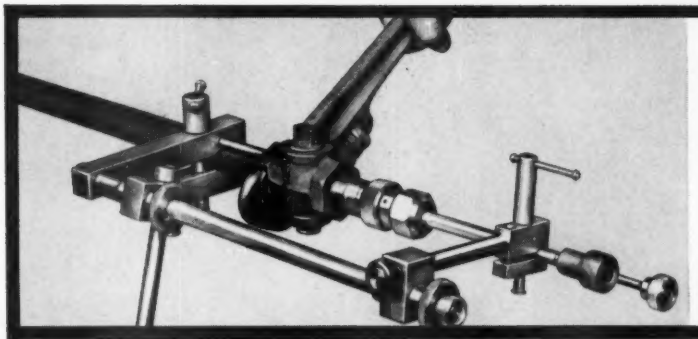
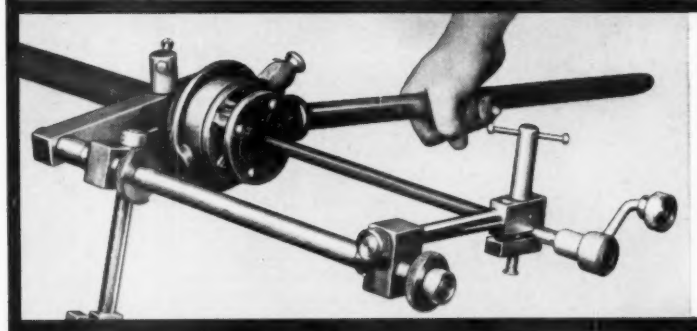


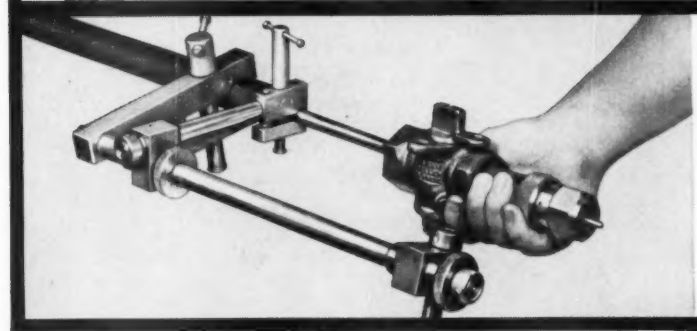
Remove old stop!

Greater swing clearance of this new model permits its use with a wider variety of stops — even lubricated plug valves and gate valves!



Cut-off and rethread pipe!

Greater length of both the safety clamp and the plugging units of Model #2 permits damaged threads to be cut-off and the pipe to be rethreaded before installing the new stop.



Install new stop!

New stops may be installed quickly under pressures up to 60 p.s.i. without bucking line pressure and with no blowing of gas.

This new model of the H-17010 Stop Changer makes Mueller's exclusive No-Blo method for replacing obsolete or damaged gas stops under pressure **even more versatile than before!** It is typical of the constant attention to detail in research, design and engineering that becomes a part of all Mueller No-Blo products manufactured for the gas industry. Write for complete information today.

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Cincinnati goes underground with LPG

GAS

DECEMBER 1959

By WILLIAM J. SCHREINER
Supervisor of Engineering
Cincinnati (Ohio) Gas & Electric Co.

NEARLY all engineering problems involve economic considerations in their proper solution. Cincinnati Gas & Electric Co. solved its seasonal peak-shaving problem by adding a propane-air gas plant and a pipeline-supplied underground storage cavern to its system.

The gas plant can produce 50 MMcfd of propane-air gas at 200 psig. It went in service last month.

The 7.5-million gal. underground cavern is the first use of this method of storing liquid propane by a gas distribution utility. Propane feedstock comes from the Little Big Inch pipeline of the Texas Eastern Transmission Corp.

Converting the war-time built Little Big Inch pipeline from natural gas service to petroleum products, including LPG, was begun in 1958. This conversion, which insures a lower cost of feedstock, was an important factor in the solution of the peak load problem at Cincinnati Gas. The products pipeline system's economy depends on large supplies of propane and other petroleum products on the Texas Gulf Coast, with underground accumulation caverns at the pipe line origin stations. These accumulation caverns provide working storage for shippers. They also provide accumulation of enough propane for pumping into the Little Big Inch line at suitable rates without regard to pumping capacity of individual suppliers. From the origin stations, propane is transported directly into terminal storage caverns of the users, including the Cincinnati Gas cavern at Todhunter, between Middletown and Cincinnati, Ohio.

The first deliveries of propane from the Little Big Inch line were made in the winter of 1958 into temporary storage facilities. Completion of the cavern, built for Cincinnati Gas by Texas Eastern Transmission along with four other caverns, will give Todhunter the largest terminal storage of propane in the world (*see Fig. 1*).

At left is a view of the cavern passageway.

Development of the overall project has involved many interesting decisions in the solution of its economics studies and engineering problems.

SYSTEM LOAD VARIATIONS

The composite load variation in a gas utility due to its domestic, residential, commercial, public and industrial customers shows the well-known increasing variation from peak day to minimum day determined by time of year and weather. The increasing maximum demand shows the need for studies of the most economical method of supplying the demand. In other words, an increasingly greater proportion of the total cost of doing business is determined by maximum demand.

• Economics studies

The economy of peak-shaving is determined by a load curve showing variation in demands, together with their duration. A typical load-duration curve is shown in *Fig. 2*. From the load-duration curve the daily capacity and annual capacity of the peak-shaving facilities can be determined.

• Plant characteristics

Present peak day gas supplies are pipeline deliveries, manufactured gas, and storage. If the base gas is natural gas, cost of gas manufacture and storage can be readily compared with existing natural gas demand rates to indicate savings possible from the various methods.

Since the amount of savings possible from peak-shaving depends upon the annual operating cost of the type of facilities selected, both investment and operating cost of the peak-shaving plant must be considered. Propane plants and underground storage have the lowest investment cost. This fact, combined with low operating and feedstock costs obtained from pipeline deliveries, led to the choice of a propane plant. The economy of this selection is further emphasized if the plant is to produce only a relatively small volume of annual gas.

As the result of such typical load studies, a capacity of 50 MMcfd was selected as the most economical size for the process plant. The cavern capacity of 7.5 million gal. will accommodate approximately 250 hours of full plant operation. Since the cavern is capable of refill from the Little Big Inch line, a typical delivery schedule insures stability of operation for the process plant on winter peak loads.

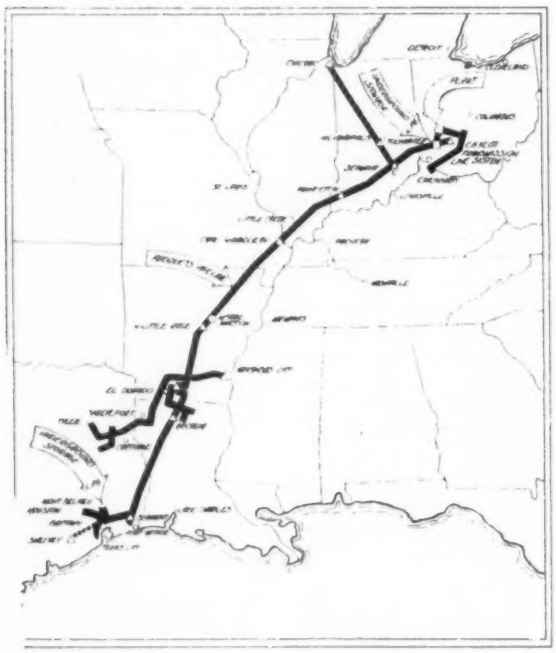


Fig. 1. Propane pipeline, storage and production system.

LOCATION OF PLANT, FACILITIES

The cavern was necessarily located adjacent to the Little Big Inch pipeline and in an area with suitable zoning for underground storage of large volumes of liquid propane. The location is also remote to residential areas where blasting would be considered a nuisance.

The economics of plant location were primarily determined by the necessity for delivering peak load supplies into a transmission system containing a sufficient amount of natural gas for mixing with the plant output to produce substantial mixtures. And the transmission system had to be large enough to accept increased deliveries downstream of the plant which would result from addition of plant output to the natural gas supply. To accomplish this, Cincinnati had to obtain a new high pressure natural gas delivery point from the Ohio Fuel Gas Co. at a junction of the interstate natural gas transmission system and the Cincinnati transmission system. This location was on a hill near Dicks Creek, south of Middletown, Ohio, in the north central part of the utility service area.

A specific location within the general area determined by availability of natural gas and transmission facilities was predicated upon minimum investment in mixed gas discharge line, minimum line for feedstock supplies, minimum length of electric supply line, minimum length of water supply line, and minimum land costs. The site selected at Dicks Creek met all these requirements and also had suitable terrain features. It is in a country area zoned for industrial use which allowed the manufacture of gas, and was distant from residential areas.

STORAGE AND PLANT DESIGN

• Cavern location, depth, and size

Standards of the Natural Gasoline Association of America provide that propane storage caverns be located at least 200 ft below the ground surface

to provide sufficient overburden to contain propane pressures at existing underground temperatures. This requirement fixed a minimum depth for a geological formation suitable for the cavern. By general knowledge and preliminary geological investigations, we learned that thick strata of lime stone and shale suitable for underground propane storage caverns lay under the Cincinnati area. The formations were deep enough to furnish an overburden needed to contain the pressures, yet not so deep as to appreciably increase shaft drilling expenses. The adaptation of roof bolting practices used in the mining industry made it possible to select a shale formation at an economical depth of about 350 ft at the Todhunter site in Butler County (See *Fig. 3*).

After the preliminary investigation, the geology of the site was thoroughly investigated with 3-in. core drilled holes. Examination of cores furnished information as to the character of subsurface rock formations. This drilling also produced observations necessary to insure that other objectionable factors, such as the presence of gas, oil, or coal, would not be encountered. Core holes were pressure tested to 1.5 times the expected cavern pressure before acceptance. They were tested to determine physical characteristics of the shale such as permeability to air and propane, porosity, specific gravity, water slaking, and reaction with propane.

To maintain the reliability of gas supply needed in utility operations, the feedstock necessary for peak load operations must be available in sufficient quantities to meet annual requirements for peak load gas. This factor fixed the size of Todhunter cavern in consideration of the possibility of replacing stocks in approximately two weeks by pipeline if unexpectedly severe conditions should arise.

• Cavern construction and testing

Economy in cavern construction and testing followed modern developments in this field. Forty-two inches was selected as the diameter for the main shaft. This shaft introduces the propane used to fill the cavern. During construction, the 42-in. shaft was used with a derrick and 150-hp hoist to remove mined material or muck. It also served as access for personnel and machinery used in the mining operations. The 42-in. size selected was the smallest shaft able to meet these requirements, and at the same time give economy in drilling and simplicity of sealing against propane pressures.

In addition to the main shaft, two 12-in. shafts and a 20-in. shaft were drilled from the surface into the cavern formation. Primary purpose of these holes was to provide for installation of a float gauge to indicate liquid level in the cavern and for installation of two deep well pumping units that supply propane from storage to Dicks Creek process plant.

During construction the 12-in. shafts were used for introduction of air necessary to vent the cavern. Air was supplied at the rate of 8000 cfm. Air was removed through the 20-in. shaft. It also served as an escape hole for mining personnel, if necessary. Compressed air, water, and electricity were carried into the cavern through pipes welded to the outside of the 42-in. casing. Compressed air was furnished by a 600-cfm air compressor.

The main shaft was rotary drilled (*Fig. 4*) without serious drift by starting with a 17-in. pilot hole and following directly with the 52-in. hole. The reverse rotary method was used to sink the hole. In this method, cuttings are pumped out of the hole through the drill shaft's hollow center. Drilling holes of this size to depths of 350 ft was not attempted until the application of the method for mining LPG storage caverns made it possible.

Mining at a single level facilitated the honeycomb type of construction with 35-ft square supporting pillars, and passageways about 20 ft wide at the bottom, 15 ft wide at the roof, and 30 ft high. The walls and pillars prevented cave-ins. The sloping wall construction furnished maximum support. The general arrangement is shown in *Fig. 5*.

The header and bench method of drilling and blasting was used in mining. The upper third of the face was removed first, about 25 ft ahead of the bench. Excavation of the bench was done in a way to retain the shape of a ramp to permit the removing tractor to reach muck at the top of the heading. Blasting was done at the end of each shift to allow an adequate time for exhausting the air before work was resumed. Upon completion of a section of the cavern, roof bolts, supporting plates and wire mesh

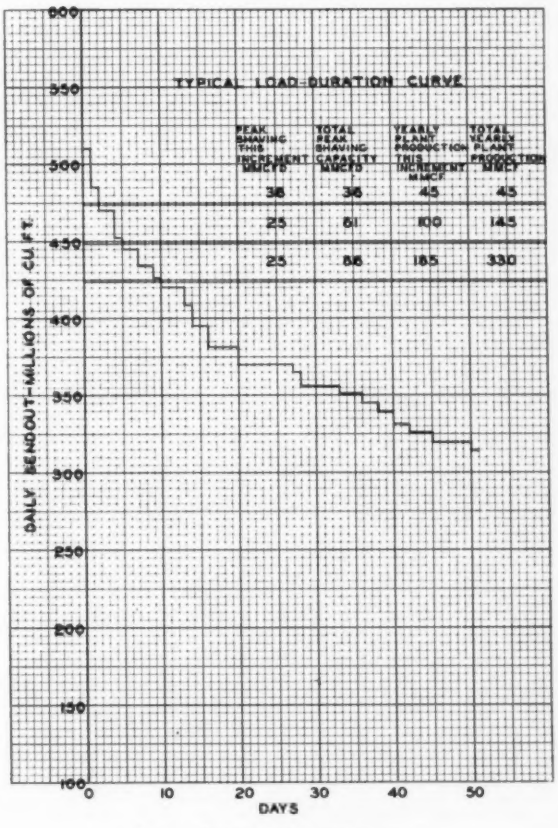


Fig. 2. Typical load-duration curve.

were installed in the ceiling (see first page).

Proper selection of the main shaft size and mining machinery made possible round-the-clock operations on a shift basis. Removal rates reached as high as 30 cu yd of muck per hour. The hoist which raised muck from the cavern and deposited it through a chute to the ground operated at 2000 ft per minute. Deposits were later spread over the surface area and leveled by bulldozers. A tractor shovel removed muck from dynamited faces to accessible piles. From these piles muck was transported to the removal shaft by compressed air-operated mucker loaders running on tracks. These loaders scooped the muck and dumped it directly into buckets on the back of the carriage. The loader traveled directly to the hoist area; the hoist was attached to the buckets, and muck lifted to the surface.

After completion and sealing, the cavern was tested at 150 per cent working pressure by a 7-day closed-in test. Observations of the uniform pressure with temperature corrections were made possible by a reference cylinder connected to cavern piping. Upon completion of the test, the mined volume calculations were verified by measuring and correcting the volume of air discharged.

Purging and pressuring the cavern was done by warm propane vapors which prevented any refrigeration effects that might be experienced if liquid propane was introduced at atmospheric pressure. Propane vapors were injected at the bottom of the cavern and, being heavier than air, forced air out at the top. A sample indicated presence of pure propane vapors. Then, the cavern was closed and brought up to operating pressure by admission of propane vapor. Explosibility tests were made at the stack and in the area as the purging operation proceeded.

• Plant structures and locations

With the process plant location fixed by the location of the storage cavern, natural gas supply system, and delivery transmission system, the most economical and safe layout was arranged. A mile-long public water supply of 6- and 4-in. Belltite cast iron pipe was chosen in preference to an on-site deep-well pumping operation. This avoided water treatment, and operating and maintenance problems for the peak load service in which the plant would be operated. Propane feedstock was supplied from submersible deep well pumps in duplicate, located at the cavern. The propane was transported to the plant through one mile of 6-in. welded steel pipeline. Electric power supply was obtained from an adjacent 66 Kv transmission system.

The plant layout itself provides separate buildings for steam generating equipment, propane vaporizing equipment, and compressed air supply equipment. A combined office and central control station was adjacent to the boiler house and separated from it by a brick fire wall. This arrangement isolated dangerous operations from non-explosive installations,

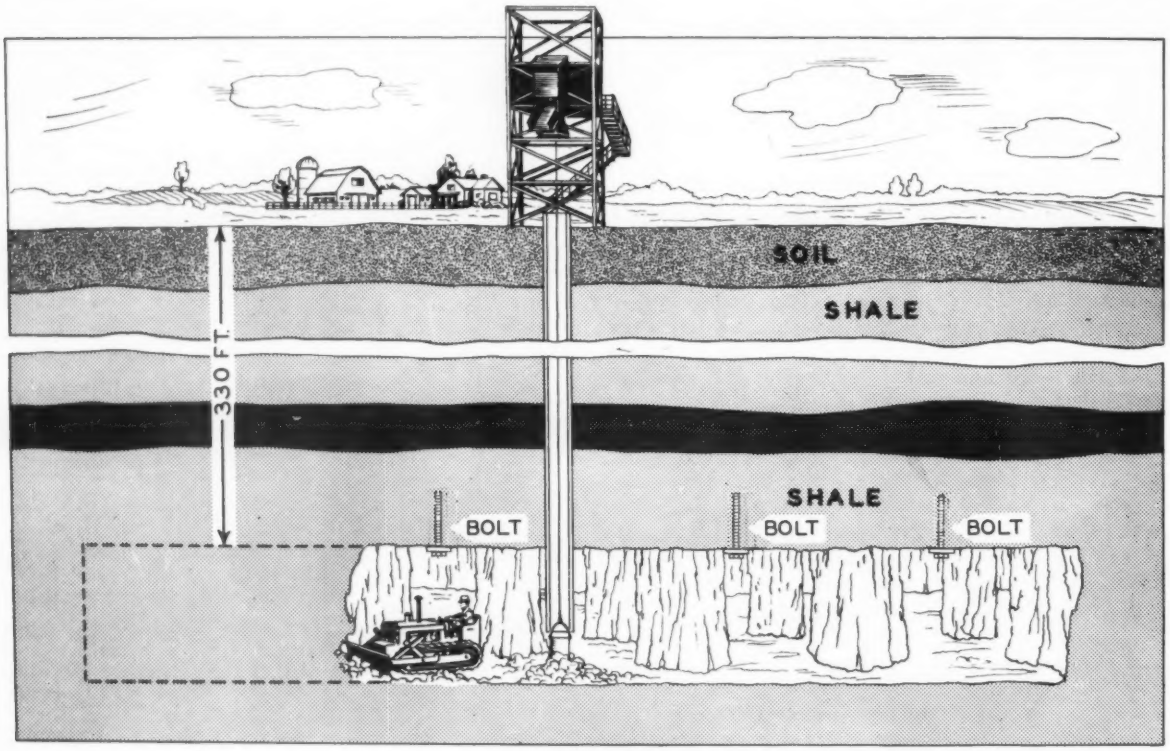


Fig. 3. Underground storage cavern.

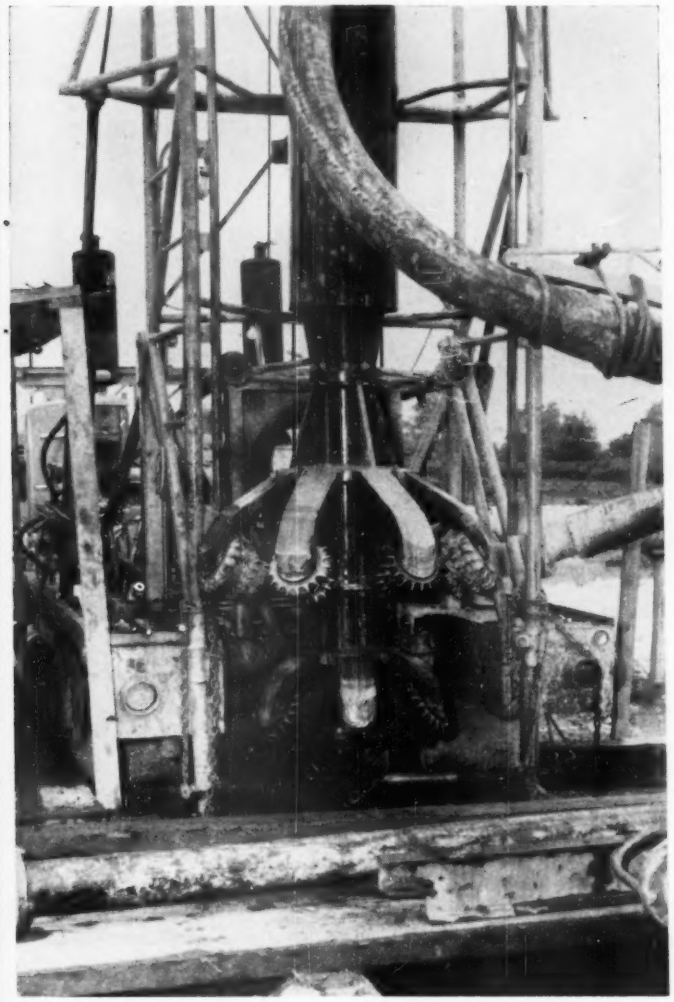


Fig. 4. Rotary drill.

and minimized the use of explosion-proof accessories. It also gave the most economical arrangement for interconnection of service piping, thus shortening piping and control runs.

The plant layout (*Fig. 6*) provides for a compressor station on the west to be accessible to high voltage electrical equipment. This electrical equipment is as remote from the main buildings as possible. The vaporizer house, by necessity, is in the middle because of the economics of supply lines from both directions. This located the boiler room on the east side of the property. Specifications for safety of vaporizer equipment provided that they not be in the same room with open flames. Fifty-foot spacing between buildings is an added safety feature. In addition, the west side of the boiler house (next to the vaporizer house) has no openings lower than 3 ft above ground.

The circulating water system, in addition to its cooling tower, includes a 20,000-gal. reservoir for storage, to limit the dependence of the plant on outside water sources.

• Plant equipment and design

Interesting features of the design and selection of equipment were encountered in each of the several major components of the plant. Operation of liquid propane deep-well supply pumps at the cavern was by remote control from the plant control room. Pumps and delivery equipment were chosen on the most economical basis to supply liquid propane to the plant at 150,400 lb per hour at 130 psig. A 30,000-gal. propane receiver tank was located at the plant to insure stability of supply and to furnish propane for operation in case of temporary outages. Two 600-gpm pumps are located in parallel downstream of the receiver to supply liquid propane to vaporizers at 230 psig to meet plant service pressures. Propane is odorized at this location for service conditions as well as for plant safety. All equipment is outdoors. Liquid propane metering is arranged for the control of plant operations.

Steam was chosen as the medium for vaporizing propane rather than direct fired heat exchangers, for safety reasons. Steam is supplied by two 17,500-lb per hour 100 psig fire-tube, package-type boilers with necessary safety and blowdown valves and accessories. Dual burners were provided for alternate natural gas and propane firing, with automatic combustion control units, and ignition and fuel safety innerlocks to integrate steam, air, and fuel relationships. Forced draft fans are part of the package boilers. Combustion air passes through gas-fired preheaters to improve efficiency, and to avoid low room temperatures. Feed water is supplied from a deaerating heater.

Propane is vaporized in two 15 million Btu per hour vaporizers; supply is regulated by liquid level controllers. Steam is supplied from the boilers through regulators and mist eliminators and, in proper amounts, by coordinating the regulators with the propane vapor requirements. Steam condensate is returned to the feed water heater and boilers by means of condensate pumps. Propane-air gas is mixed to suitable heating value by a volumetric proportioning system made up of interlocked metering butterfly valves which maintain fixed differentials. Control of the butterfly valves is by regulators and an oil pressure system. Pre-determined heating values are maintained by refining the volumetric proportioning through a Calorimixer which insures the proper Btu. The propane-air gas is properly mixed in a mechanical mixer downstream of the proportioning equipment, and its volume is measured through an orifice meter.

Reciprocating air compressors were chosen for the high pressure variable load service as more generally suitable than centrifugal compressors. Two compressors, each capable of supplying 433,000 scfh of compressed air at 225 psig were installed. They are the four-cylinder, two-stage, balanced opposed type. Each is driven by a 1750-hp, 4000-v, 327-rpm synchronous motor. Electric motors were chosen as the most economical prime movers, giving minimum investment and maintenance expense for the intermittent type of plant service.

Each compressor is equipped with oil-impregnated mat type air filters, and suction and discharge pulsa-

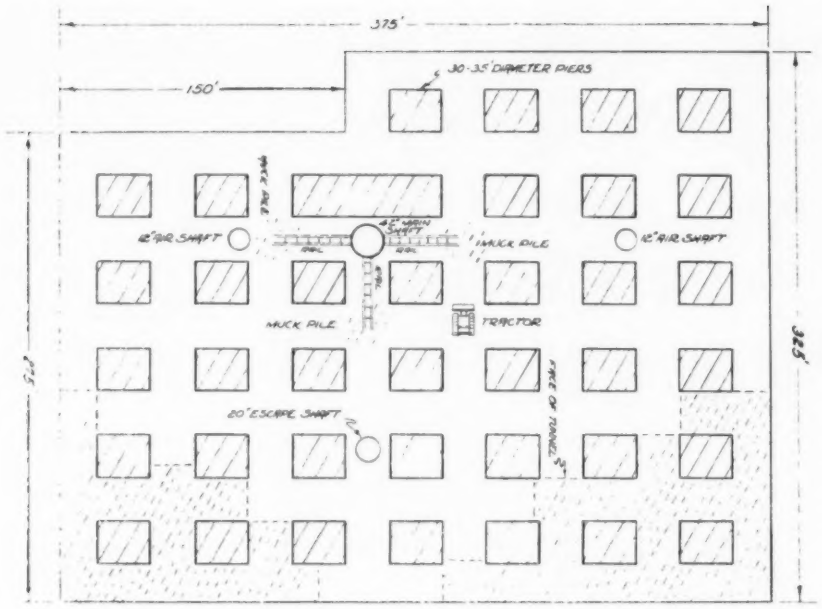


Fig. 5. Plan of Todhunter storage cavern.

tion dampening cylinders, as well as intercooler, and aftercooler. Separators, oil mist extractors and a silica-jell regenerative drying tower insure a supply of dry air at approximately 65 deg F, for mixing with the propane. The air dryer is the regenerative desiccant type, capable of removing moisture from 100 per cent saturated air at 70 deg F to a dewpoint of minus 40 deg F at 220 psig on an eight-hour operating cycle.

The compressor, intercooler, and aftercooler water is cooled in a cooling tower. The cooling tower is integral with the city water supply, which furnishes makeup and necessary auxiliary plant water. In the capacity involved in this plant, it was not economical to use an auxiliary heat exchanger between the cooling water and propane heating system because of heat transfer values.

Natural gas from the high pressure transmission system is supplied to the plant through a regulator and orifice meters. Natural gas supply is heated to avoid refrigeration effects which would accompany pressure reduction. Heating is ahead of measurement and regulation to reduce the size of heating equipment and attendant expense. Natural gas is mixed with propane-air gas in a mechanical mixer and supplied to the company transmission system at necessary pressures. A by-pass around the mixing system makes possible a direct supply of natural gas when the plant is not in operation.

The mixing system adopted gives the operator both process control and sendout mixture control, thus enabling him to automatically meet loads with optimum economy and substitutability. Plant sendout is controlled by selecting air volumes in steps of approximately 108 Mcfh by manual control of the compressor pneumatic loading devices. The gas proportioning equipment automatically controls blending the propane vapor and air streams to satisfy changes in volume while maintaining the heating value of the propane-air mixture. Since desired heating value is also a function of the variable percentage of peak shaving at which the plant may be operating, the equipment, sensing the percentage of peak shave, adjusts heating value to established limits. The natural gas system contains a ratio controller which automatically maintains the proper proportion of substitute gas to base gas. The overall result is maintenance of proper heating value for optimum substitutability and economy as the substitute gas and base gas change.

• Safety

Safety in a peak load gas plant involves the prime consideration of supplying a suitable gas which is substitutable for natural gas in the proportions in which it may occur in customers' appliances on peak loads. Preliminary tests of all mixtures were made to determine the most economical composition of substitute gas that was interchangeable with natural gas in various proportions. Composition of this gas is maintained automatically at the plant by Btu-volume mixing control.

Within the plant, safety and continuity of service are maintained by pressure control and relieving devices, indications of dangerous mixtures, and auxiliary safety devices on individual equipment. The possibility of gaseous mixtures in the vaporizer house is minimized by floor level ventilating louvers in walls, and roof ventilators which supply fresh air to the vaporizer house with prevailing winds. Gas mixing equipment is also located in the isolated vaporizer house.

Combustion and possible sources of ignition are isolated in the boiler house. Control is in a central

Fig. 6. Aerial view of Dicks Creek plant layout.

control room isolated from the boiler and vaporizer houses. Heavy machinery and electrical equipment are isolated in the compressor house. Propane handling and storage equipment is located outdoors wherever possible. Small pressure relief valves are installed between successive liquid propane valves that might be shut, to avoid build up of excessive pressures due to high temperatures.

Important individual equipment and appliances within the plant are equipped with safety devices to prevent malfunctioning. The vaporizer house and other important locations are equipped with a combustible gas sampling system which rings an alarm whenever a dangerous concentration of propane exists in the atmosphere. The plant is also equipped with an emergency shutdown system which, in case of low pressure or loss of flow conditions, operates to automatically shut-down the entire plant.

In addition, manual operation of a crash valve located outside the plant area isolates the plant and by-passes natural gas, shuts off flow of liquid propane to the plant and relieves excess pressure on the vaporizers permitting propane to return to the storage cavern.

For the sake of appearance — as well as added safety — as much wiring and piping was kept underground as possible. A color code based on the ASA A13.1 Scheme for Identification of Piping Systems is applied to the plant piping. Fire protection is provided by chemical extinguishers strategically located.

• General arrangement and operations

The general arrangement of the equipment and its operation is shown in the flow diagram (*Fig. 7*).

The plant loads are maintained by the operating organization under direction of the system pressure supervisor who determines the need for peak load supplies.

ENGINEERING, CONSTRUCTION

• Office engineering

Plant design and office engineering followed modern trends in this field and were executed by the company's engineering department. This arrangement was the most feasible and economical because of experience gained in preliminary engineering investigations that were made to establish the worth of the project, as well as experience in the operation of the company's existing 12MMcfd propane air plant. This engineering, together with modern developments in equipment, made possible the economical design described above.

• Superintendence of construction

Intimate contact with propane-air plant construction and operations also made possible the selection of competent company personnel for superintendence of construction.

Experience of this superintending force was further enhanced by its familiarity with the availability and efficiency of local contractors competent for construction, and area labor problems. It also facilitated immediate access to company and independent material and service suppliers.

• Contractor selection

The efficiency of closely organized plant design and superintendence was furthered by selection of individual contractors on a cost plus basis. Contractors furnished detailed quotations of the labor and equipment they proposed to furnish, together with their

overhead and profit rates. Application of these rates to closely estimated units of construction and knowledge of each contractor's ability, knowhow, and efficiency made possible selection of the most economical construction contracts. It also furnished close understanding between superintending and engineering personnel and the contractors, to achieve the most efficient construction and expedient schedules.

PLANT OPERATION

• Work force

The work force needed to operate the plant is essentially a superintendent and shift organizations in plant control and mixing, boiler room operation, vaporizer and yard operation, and compressor house operation and maintenance.

The work force includes station, boiler, and compressor operators. Reinforcements can be obtained from other plants and operating departments as needed, both for operation and special maintenance work. The overall plan is based on the use of a part-time cadre, the personnel performing other duties at nonoperating times. At the beginning of a winter season, plant operators are placed on a part-time basis, During this period, test runs and training for all personnel can be accomplished. When operations begin, the entire force is in attendance.

• Operating periods

Since operations are necessary only at times of peak load, there must be an efficient use of the work force in preliminary operating periods and tests to insure readiness of the plant for service. The use of the cadre, or skeleton force, in the early winter period for familiarization and readiness of operation, accomplishes this end.

• Maintenance

Maintenance of an infrequently operated plant can be accomplished by use of operating personnel in the preliminary operating periods, and reinforcement by other plant and gas department maintenance personnel when necessary.

CONCLUSION AND SUMMARY

Expansion of the Cincinnati Gas & Electric's storage and plant for peak load operations has been a project of wide scope. Economy and efficiency in the expansion has been accomplished by a timely and economical addition to peak-shaving facilities, made possible through pipeline transported propane, large volume underground storage and the most efficient process plant, together with the use of available professional and operating personnel. ■

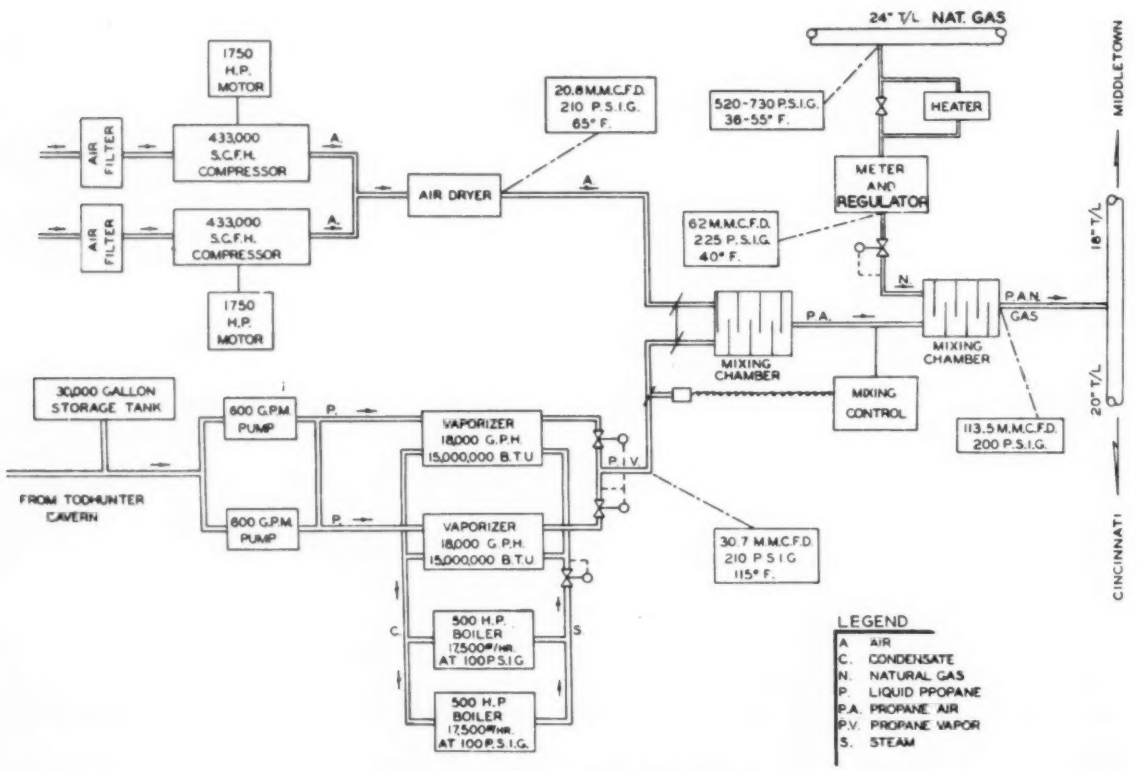


Fig. 7. Dicks Creek gas plant flow diagram.

COST REDUCTION

through consolidation of meter maintenance

By G. R. ROSE, General Utilization Engineer
and D. R. STONEBURNER, Meter Shop Foreman
Ohio Fuel Gas Co., Columbus

Hydraulic hoist at new meter repair shop facilitates unloading of meters from truck to shop floor. Specially constructed transport cars are used to hold standard size tin meters.

LIKE most utilities we have to cope with the problem of costs that tend to rise faster than income. In line with several cost cutting procedures, we recently consolidated our meter maintenance operations in a single, newly equipped shop in Columbus. Previously, we had also operated a shop in Toledo.

To handle the larger number of meters, and to streamline the flow of our maintenance work, we rebuilt and equipped the entire second floor, measuring 100 by 200 ft, of an existing two-story building on the outskirts of Columbus. Of this space approximately 10,000 sq ft is used for repair operations and the balance for storage and shipping. Among the new equipment installed are a gas-fired, 76-ton air-conditioning system for cooling and heating; an automatic overhead conveyor system for transporting domestic meters through repair processes; automatic paint remover; gas-fired top removers for tin meters; and a hydraulic elevator at the loading dock.

During its first months of operation, the shop handled about 2800 meter repairs per month. Our next goal is 3600 meter repairs per month, while the design of the shop may eventually allow us to handle as many as 4600 meter repairs and retire 1200 meters per month. In addition we test all new meters in the shop, presently at a rate of about 40,000 new meters per year. (Of these, about 25,000 are for new accounts.) All new meters are proved at two rates of flow. They also undergo a leak test and a low-light test.

In trying to handle all of our domestic meter repairs on one production line, we had one problem—about 40 per cent of our approximately 725,000 outstanding meters are cast iron hard case, while most of the balance are tin meters. Many of the maintenance operations for hard case meters are different from those for tin meters. Nevertheless, we wanted to use only one main overhead conveyor line throughout the shop.

We worked out the following system:

The two types of meters arrive at the in-test room on transport carts. Adequate storage space is provided in this room to hold the meters at least 12 hours pre-

Both iron hardcase and tin meters are handled on a single conveyor line throughout the repair shop. The need for handling two types of meters required careful planning in the layout of the new shop, which was opened recently in order to consolidate all meter repair work for the group in one location.

In main meter repair room of new meter shop, two repair lines of hardcase meters and one repair line for tin meters are presently in operation. There is space for a total of six repair lines.

ceding in-test. Meters are first proved at two rates of flow and the test data is recorded for IBM tabulation. The two types of meters are placed on the same overhead conveyor to be carried to separate operations for each type.

At the next stop the hardcase meters, after removal of index boxes and indexes, go into a Wheelabrator for removal of paint by shot blast. After receving a zinc chromate primer coat, they are placed back on the conveyor.

The tin meters go into a Metalwash automatic paint stripper. From there they are moved by roller conveyor to gas-fired opening machines for removal of tops and back-plates. Then they are tinned and placed back on the overhead conveyor.

The conveyor transports both types of meters into the main repair room, where we operate at present three repair lines, two for the hardcase meters and one for the tin meters. There is space, however, for at least six repair lines.

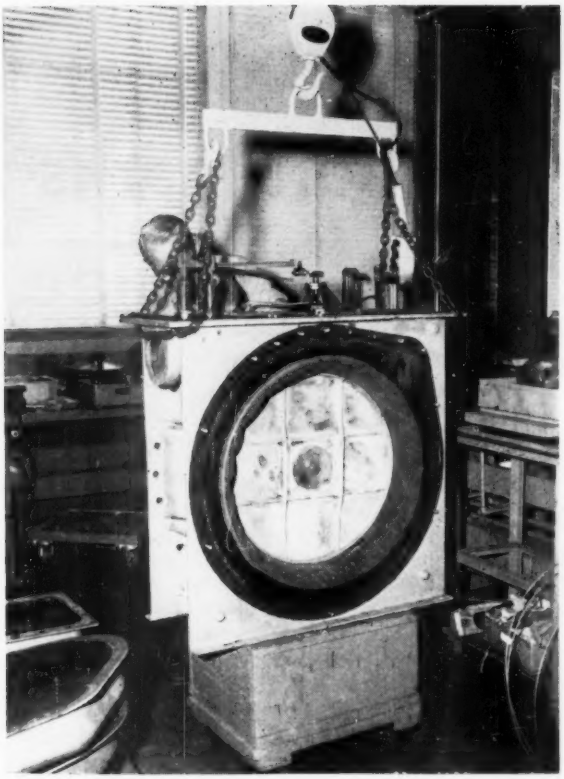
On the repair lines, the hardcase meters move forward on a continuous roller conveyor with each meter mounted in a special fixture. Each man on the line handles five meters at a time. There are five repair stations for hardcase meters, each operated by one man. The work done at each station is this:

(1) Top removed and diaphragm tested by pressure drop test; (2) sides removed, bottom parts repaired, and diaphragm replaced or re-oiled with oil kept at 140 deg in thermostatically controlled pots; (3) sides replaced, top cleaned, and worn top parts replaced; (4) valves ground; (5) top parts reassembled and bushings replaced. While this is essentially the work assignment on the line, with the arrangement we have the assignments can be varied in accordance with needs for the type of meter being repaired and the man's station is not restricted to the five meters he has before him.

The tin meters pass six repair points: (1) Diaphragms tested and top flange straightened; (2) sides removed, if necessary, diaphragms replaced or re-oiled (Vulcan synthetic diaphragms are used for all tin meters); (3) meter gallery cleaned and stuffing boxes repacked; (4) valves ground and set; (5) back plate installed; (6) body tested for leaks in pneumatic tank, and index installed.

Following the repair line, both types of meters go back on the overhead conveyor. In the out-test the meters are proved, leak tested and low light tested. The hard case meters are then sealed, and both meters receive a finishing coat of paint.

As more and more of our old makes of meters are retired, we expect to achieve further economies and a larger output in our maintenance plant. Our maintenance line will be simplified, and more meters can then be handled per manhour. We also expect that the number of diaphragms needing replacement will drop with the increasing use of synthetic dia-



Large volume meters are handled in a separate section of Ohio Fuel's new meter shop.

Consolidation of meter maintenance cuts costs

Vulcan synthetic diaphragms are used for all replacements in tin meters by Ohio Fuel Gas.

phragms. For all new domestic meters we have standardized on 250-cfh meters with synthetic diaphragms. Replacements in tin meters have been 100 per cent Vulcan synthetics since 1952. We began our first test installations with Vulcan synthetic diaphragms in 1948, and none of the synthetics installed since then, except damaged ones, have been replaced.

All meters above 10 LT are handled individually in a separate room. We process on average about 25 large-volume meters a day. This includes tests of new meters as well as repairs. We have a 50-ft Bell prover for the largest of our meters. Here each repair is handled from beginning to end by one man, from intest to repairs, leak test, and out-test.

In the same room, regulators are tested and repaired. All new regulators undergo a leak test, a lock-up test and a flow test. All regulators are equipped with synthetic diaphragms.

Finally, the shop includes a spacious room for utilization classes and other training purposes.

With this installation, we feel that we have the answer now for our meter maintenance problems in our Ohio system. The basic procedures are established through constant coordination with the other two groups of the Columbia Gas System, the Charleston (W. Va.) group and the Pittsburgh group. Test results and experiences are exchanged between the groups through a Distribution Committee. On the basis of these results, uniform procedures are established for all groups of the Columbia Gas System.

To sum up: our present economies include (1) reduction of repair cost per unit through installation of labor saving machinery which could not have been justified in the two smaller repair shops previously operated, and (2) simplified stock keeping through consolidation of replacement stock at one location.

For the future we expect further economies through (1) installation of more labor-saving equipment, including automatic provers; (2) speed-up of repair line through standardization of domestic size meters; and (3) reduction of diaphragm replacements through standardization on synthetic diaphragms. ■

Major heat promotion marks Honeywell's diamond jubilee

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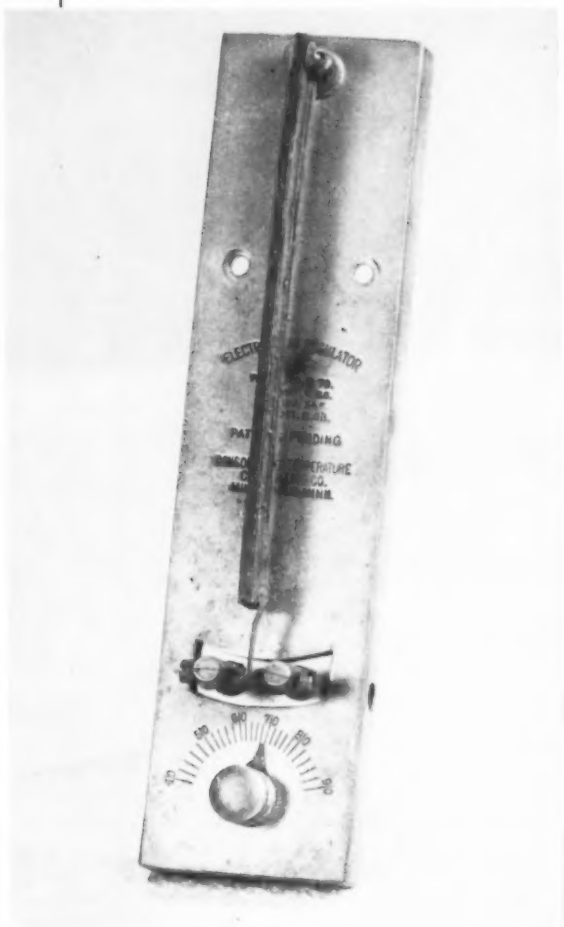


This is the first home thermostat built by a Honeywell predecessor. Upon change in temperature, the crude thermostat caused a "damper flapper" to open or close furnace damper doors through the bonding of a bimetal strip.

NINETEEN-SIXTY, the diamond anniversary of automatic heat, will be the biggest promotional year in the history of heating if plans now cooking at Minneapolis-Honeywell Regulator Co. receive industry-wide support.

Honeywell is one of two companies whose birthdate, 1885, coincides with the introduction of automatic heating. In an effort to enlist the support of all segments of the heating industry, the company has pledged record-breaking promotional funds to spearhead the anniversary observance.

This ambitious program was detailed before two

to this

The round thermostat, introduced in 1952, defied tradition. Until then, virtually all non-clock thermostats were rectangular or slightly oval in shape. The round thermostat was styled to fit the decor of any room of a home.

dozen editors of leading magazines in the gas and heating fields at a company-sponsored conference in Minneapolis in October. Acting on suggestions offered by the group, Honeywell devised a 75th anniversary symbol which it hopes will be adopted throughout the industries to unify all promotional efforts.

In keynoting the "Diamond Jubilee Showboat" presentation, Sales Vice President Kent Wilson said:

"Our belief is very strong that the best way—perhaps the only way—for us to advance our own interest is to place our primary efforts toward expanding the entire market, with the hope of getting a fair share of new or additional business from this expansion."

Advertising Vice President Herb Bissell emphasized that many of the promotional events are designed to directly benefit large segments of the heating and air conditioning industry with no direct advantages to Honeywell.

Ten "industry-centered Diamond Jubilee programs" make up the 1960 blueprint. Included are:

Operation Door-Opener, a six-part direct mail campaign. Three spring mailings (one of which is a can of fresh air from Hawaii) will stress air conditioning. Three fall mailings will remind the home owner that his heating system needs a periodic checkup, just as does his car, and reminds him that heating systems—like automobiles—must be replaced periodically.

Space is reserved in the folders for individual manufacturers' messages, and a return card with the local dealer's imprint is offered as a companion piece.

Weather Station, a campaign introducing the company's new integrated comfort control and indoor-outdoor weather information panel. The idea, as carried out in advertisements, kits, and homeowner booklets, is to "establish the Weather Station as the symbol of the modern convenience of central air conditioning."

Weather Watch, a long-range forecasting radio program. The idea behind this is to make the audience conscious of the forthcoming extremes of weather long before they arrive—at a time, in other words, when the homeowner should be thinking of buying or improving his heating equipment.

Irving P. Krick, famed weather forecaster and a pioneer in efforts to predict weather conditions months in advance, has contracted for this service.

The program will be aired over weekend "Monitor" on some 200 outlets in the NBC chain throughout the country. It will be in two six-week segments, one in spring and one in the fall. On each Sunday, three five-minute broadcasts will be made.

To focus attention on this program, Honeywell will advertise extensively and provide local-level materials.

Milady's Climate, a continuation of the 1959 consumer education campaign. Included in materials are a movie, a booklet, and national advertising.

Two-furnace, Two-Zone 1960, promoting the zone idea among owners of "quality" homes. This is a continuation of the 1959 program.

Give Em Sell, a trade education plan to help dealers develop merchandising skills. A three-part merchandising lesson will be given to them through a series of three four-page full color advertisements in a number of trade publications. Reprints will also be available in folder form.

Round thermostats pass along assembly line.

Parade of New Products, a consumer campaign to introduce the Weather Station and other new products.

Win a Wagon, a continuing advertising and sales promotion contest for dealers who sell in the industrial-commercial market. Dealers will be invited to estimate how many times a torture-test model of the new Honeywell R478 Electronic Flame Safeguard will cycle before it stops. The winner will receive a new 1901 Oldsmobile; 10 runners-up will receive gas-powered "Go-Karts."

Put Yourself in Hot Water, a program aimed at building water heater replacement sales by at least 30 per cent and upgrading 25 per cent of replacement sales to larger and higher quality models. Certain promotional activities will enable a dealer to join the "Put Yourself in Hot Water" club; four club members will win luxury vacation trips to such glamor spots as Acapulco and Bermuda.

60 Cycle in '60, a program to introduce a new line of electric heating controls.

Several of the new products to be introduced in 1960 were also unveiled. Included is an electronic cleaner designed for the home.

In addition to the discussion of products and promotions, the visiting editors were treated to a tour of the company's aeronautical laboratories. Among the space-age marvels which they saw was the space cabin simulator, which was being given final touchups before being delivered to the air force. It is in this model that the "space men" will be sealed for 30 days to test the ability of man and equipment to withstand the conditions of outer space. ■

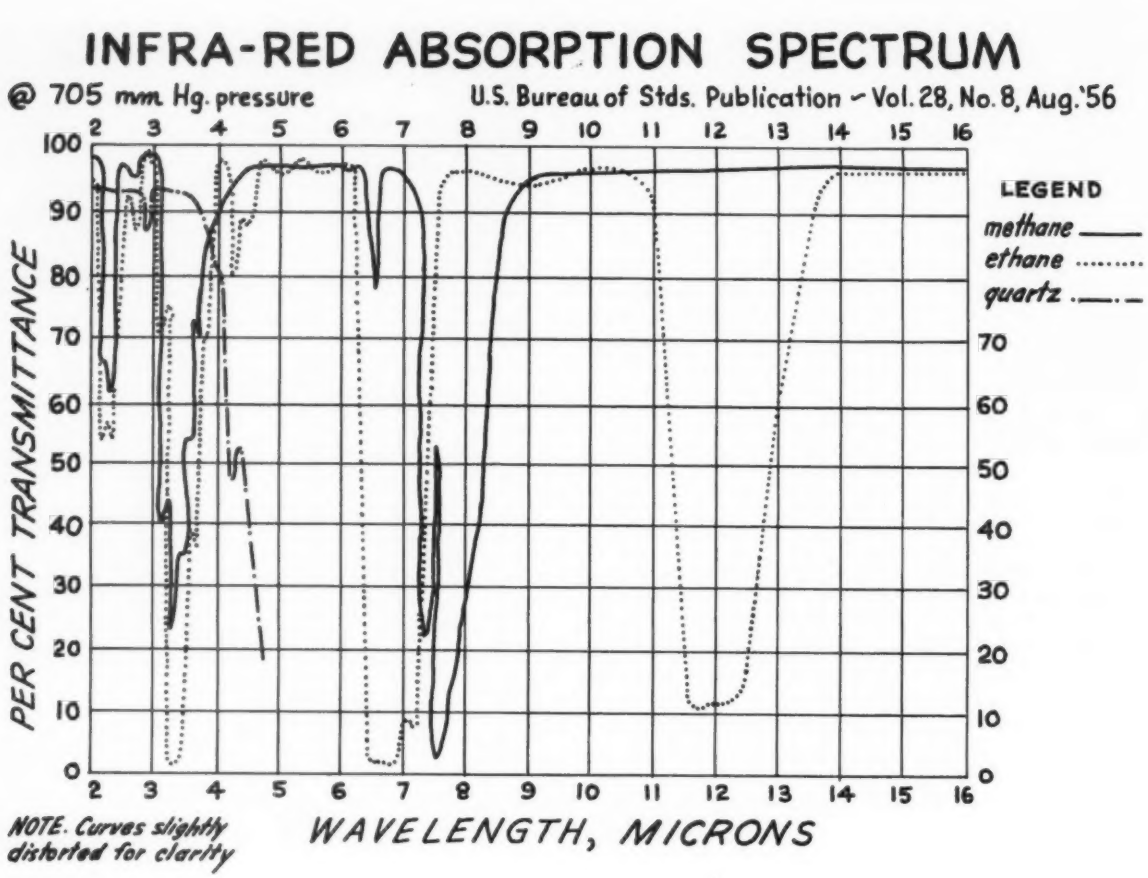


Fig. 1. Infra-red absorption spectrum.

Advanced technology

■ The use of vapor-phase chromatographic separation and broadband positive infra-red analysis techniques to qualitatively detect distinguishing components of natural gas—methane and ethane—hold promise for mobile leak detection work.

By IRVING DEUTSCH

Quality Control and Chemical Process Engineer

Long Island Lighting Co., Mineola, N. Y.

DEVELOPMENT of large diameter high pressure pipelines and demands of World War II jolted the gas industry into a new competitive position. The war demanded both use and conservation of all natural resources—especially energy sources. Demands for gaseous fuels increased at an unprecedented rate.

Use of high pressure piping for transmission and distribution provided advantages enjoyed by distributing electricity at high voltages. But these advantages were offset somewhat by the greater hazard from leaks and breaks in the main.

Every effort is being made to use the most advanced technological developments to benefit the public safety and welfare and reduce operating cost.

A leak detection device must be a dependable,

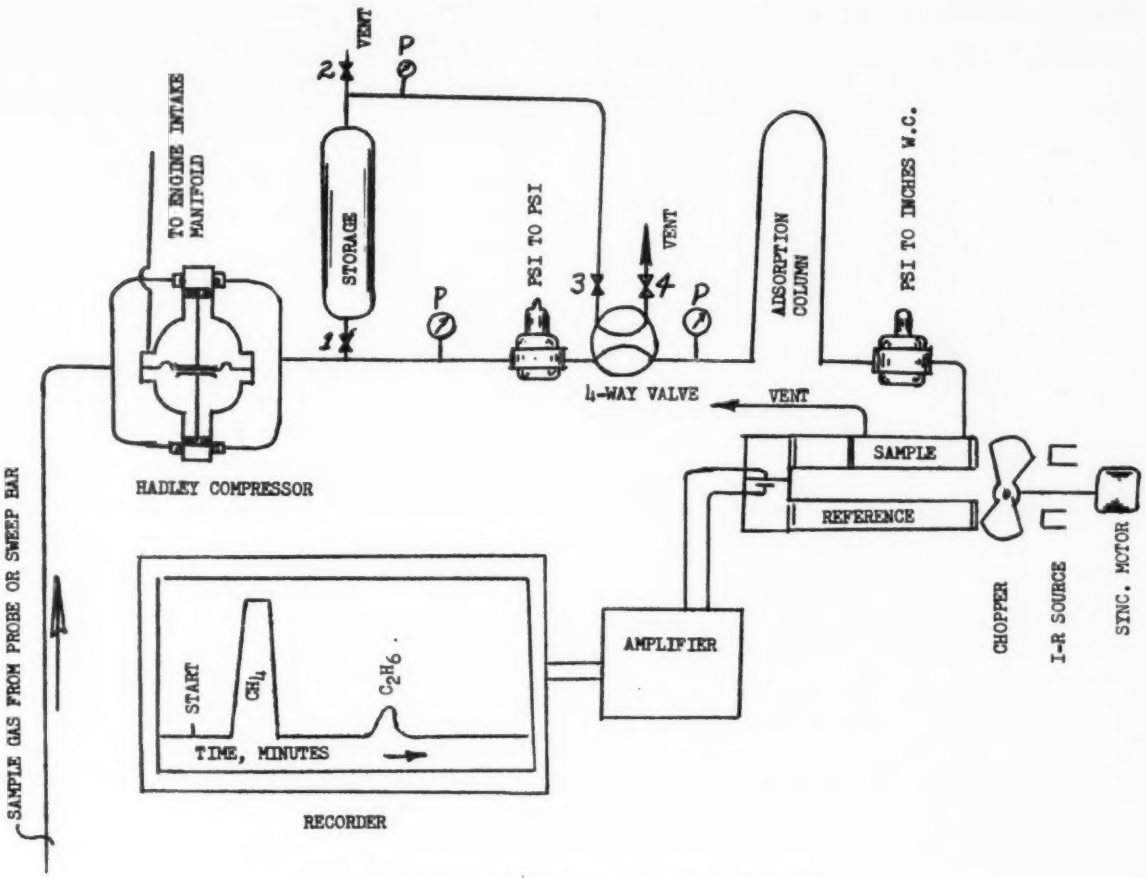


Fig. 2. Schematic flow, positive I-R detection of ethane.

applied to leak detection

rugged device. It must permit the rapid detection of leaks with little or no effort on the part of the user. The device will be subjected to severe temperature changes in the field. Hence it must remain stable when subjected to changes of as much as 30 deg. F.

The positive infra-red absorption analyzer was selected primarily because the U. S. Military Services were and are making widespread use of such devices. As often happens, experience showed that the device did not quite meet the requirements because of unforeseen complications.

This article deals in general with the application of advanced technological developments to the gas industry. More specifically it is desired to use vapor phase chromatographic separation and broad band positive infra-red analysis techniques to qualitatively detect methane and ethane, the distinguishing components of natural gas, in a leak detection vehicle.

• Historical background

Ten years ago the highly populated urban and suburban areas of the United States were supplied with fuel gas made directly or indirectly from coal. It was a simple matter to detect and distinguish this manufactured gas from other combustible gases and vapors. This was due to the presence of characteristic olefins (or illuminants), carbon monoxide, and a dis-

GAS exclusive

TABLE 1. TYPICAL ANALYSES OF GASES

	Natural Gas	*Water Gas*	*Reformed Natural Gas*	*Sewer or Marsh Gas*
CO_2	00.7	7.0	3.0	30.0
Ill.	—	10.0	0.0	—
O_2	—	1.0	0.0	0.0
CO	—	26.0	10.0	0.0
H_2	—	28.0	30.0	2.0
CH_4	94.0	12.0	40.0	65.0
N_2	00.4	16.0	17.0	3.0
C_2H_6	3.5	*	*	—
C_3H_8	00.8	*	*	—
Butanes	00.3	*	*	—
Pentanes plus	00.3	*	*	—
H.V. BTU/ft³	1037	537	537	

*=Included with CH_4

tinct odor resulting from a mixture of mercaptans, cyclic sulfurs, and innumerable gum formers such as indene and styrene. The gas also contained the entire series of volatile paraffins.

With the advent of natural gas from oil fields, it was necessary to find new means of telling fuel gas from soil gases and volatile liquid gasolines.

The typical analysis listed in *Table 1* shows that the obvious constituent to distinguish natural gas from soil gas is ethane and to distinguish natural gas from gasoline is methane and higher paraffins on a quantitative basis. In practice, it is difficult if not impossible to state definitely if gas (natural gas) is or is not present on a quantitative basis because of soil filtering action and dilution.

The average liquid absorption tests for methane are accurate to + or − 2 per cent at best. The test for ethane with liquid absorption analysis is valueless. All higher hydrocarbons are calculated as ethane (if determined).

There is a need for more rigid leak survey practices because of the 10-fold increase in the use of gas. And, because of the greater pressures used in pipeline and distribution practice. The first step in the comprehensive detection program was to make use of a positive infra-red analyzer. It was mounted in a vehicle of one sort or another to detect only methane. Actual practice showed that this would not do because of the presence of soil gas. A majority of the leaks reported proved to be nothing more than soil gas.

A laboratory gas chromatograph using a thermal conductivity detector helped solve most problems since ethane could be detected in trace quantities. However, samples had to be collected and transported to the lab—sometimes 70 miles away. Also, many infra-red detectors were purchased by gas companies at an investment of some $10,000 each. The infra-red detector has the advantage of great stability despite wide and rapid temperature changes that would be encountered in a mobile unit.

• The problem

The problem was to convert the existing equipment so that it could be used to detect methane and ethane at minimum expense and trouble. After a look at the absorption curves for methane and ethane (*Fig. 1*) one would be tempted to make use of the ethane absorption band between 11 and 13 microns wavelength. The problems created by trying this would be many. For example, many interfering materials would have to be considered. Also, a double set of optics would cost more than a second infra-red unit.

The fact that both methane and ethane have an absorption band between 2 and 4 microns wavelength greatly simplifies the solution of the problem (*Fig. 1*).

The benefits of rapid, comprehensive detection equipment to the public, and utilities, is obvious.

• Object

Primary aim of the work was to use a positive infra-red methane detector to detect ethane as well as methane. The unit is now in wide commercial use.

The detector would, without optical change, detect methane and ethane, first by separating the two by gas chromatography. The combination of vapor chromatography and broad band infra-red offers a greatly simplified analytical tool.

No effort will be made to develop the theory of chromatographic separation or infra-red absorption.

• Proposed solution and equipment

A Model 29 Beckman positive methane infra-red detector mounted in a stationwagon was used to detect natural gas leaks. Suction of the engine intake manifold was used. It drew a sample of atmosphere through the sample cell from a probe or sweep bar mounted on the front end of the vehicle. *Fig. 2* and *Fig. 3* show a schematic of the revised flow setup and a photo of the test equipment in the vehicle.

A Hadley air compressor compressed the sample to roughly 30 psi. Part of the sample was permitted to enter storage container S. Another part was regulated to about 20 psig and passed through a four-way sampling valve. Then it entered the 14-ft silica gel

Fig. 3. Test equipment setup in stationwagon.

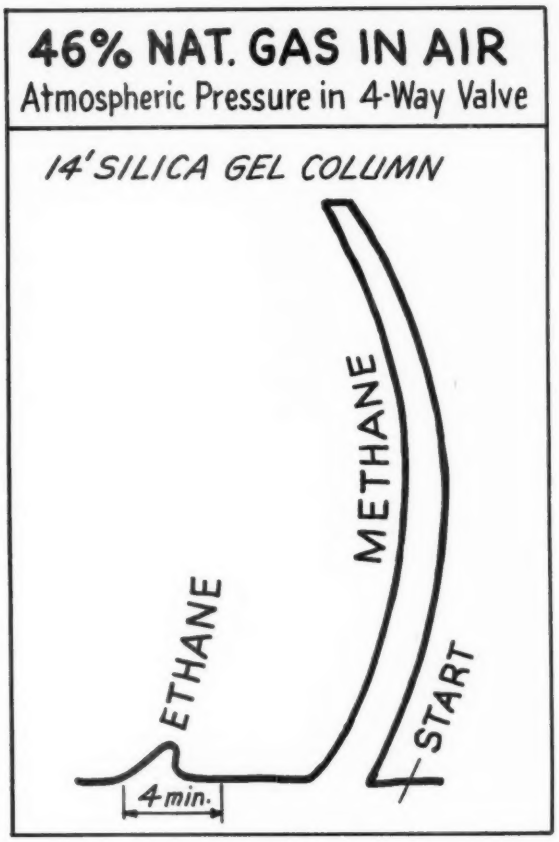


Fig. 4.

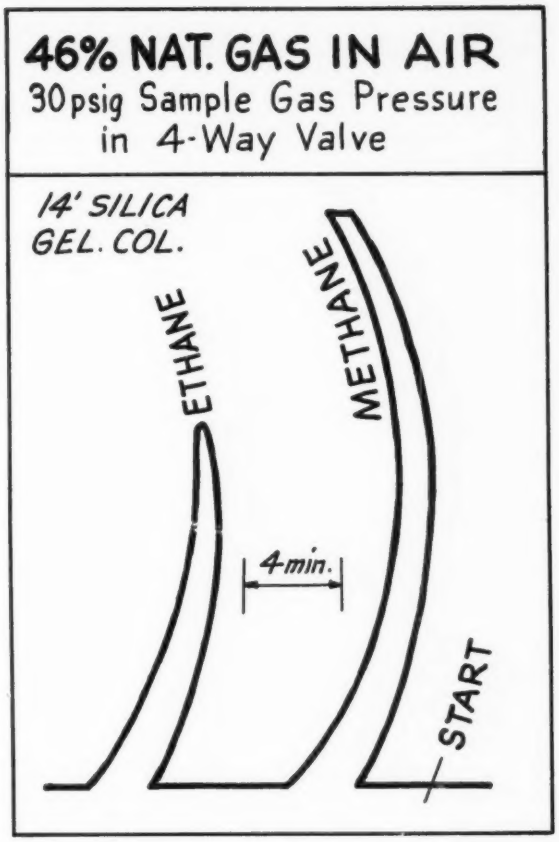


Fig. 5.

column for separation. On the downstream side of the column the sample is regulated again to 6-in. w.c. pressure (.22 psi) before it enters the sample cell of the infra-red detector.

The gas sampling valve could be either a six-way or a four-way valve. A Walworth ¾-in. four-way valve was used because of its ruggedness and low cost. The regulators were regular gas appliance spring-loaded regulators.

The 14-ft silica gel column was of standard ¼-in. OD copper tube filled with 35-60x silica gel.

The recorder is an Esterline-Angus 5 milliamp clock manual recorder.

• Procedure

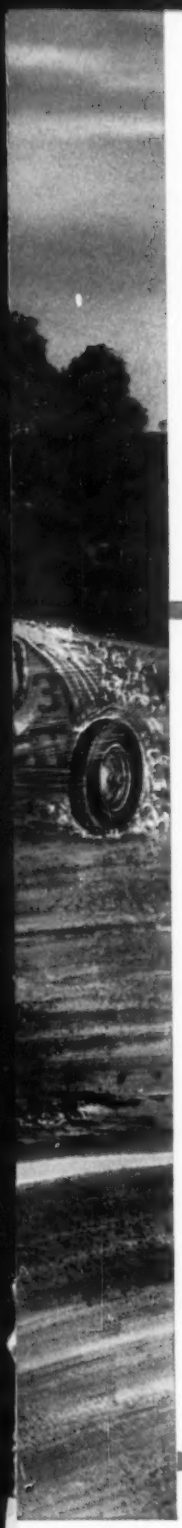
Originally the sample was drawn in through the sample cell shown in *Fig. 2* by the suction on the engine intake manifold. This was changed to overcome the pressure drop through the 14-ft silica gel column. Two procedures are available depending upon whether the atmosphere is contaminated with methane. When the atmosphere is contaminated, the following procedure is used:

Atmosphere to be sampled is drawn through probe or sweep bar and compressed to about 30 psig. Valve No. 1 is open. Valve 2 is cracked to permit flow through the storage container S, at about the same rate of change that occurs in the column. Valve 4 would be closed and valve 3 open. When a reading is obtained showing methane or ethane, the engine should be stopped to permit the storage container S to be filled with the sample to be analyzed. Then valves 1 and 2 are shut to trap the sample. The vehicle is brought to a point where clean carrier air is obtained and the recorder returns to the zero reading. The sample side of the four-way valve is filled by opening valve 3 and cracking valve 4. A film flowmeter is used to measure the amount of sample and carrier air flow. The four-way valve is given a 180-deg turn to put the sample in the stream. Starting time is marked on the chart. If methane is present, a peak will be observed at a retention time of 1 to 4 minutes depending upon column length and temperature. If ethane is present a peak will be observed in 4 to 12 minutes.

A known gas standard is used to obtain peak height and retention time, and to check the operation of the machine.

When the atmosphere is not contaminated the following direct and rapid procedure has been developed: When using the probe it was only necessary to draw a sample into the probe from a bar hole or manhole or underground structure or whether gas is suspected for a measured length of time (about 10 seconds). Then, by removing the probe from the hole to the clean atmosphere, the sample is simply and

ROCKWELL- Nordstrom **VALVES**

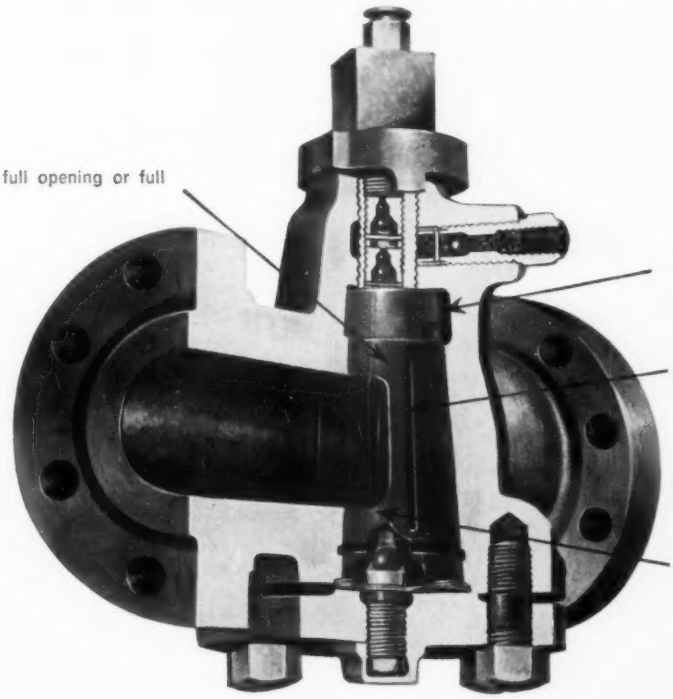


Where control is vital

It isn't just speed and power that wins races . . . it's *control* that makes consistent winners.

It's the same with valves. Valves that are awkward or slow to operate may "lose the race" against impending disaster or costly flow control errors. That's why, wherever flow control must be instantly responsive, you'll see Rockwell-Nordstrom lubricated plug valves. Their *quarter-turn* lubricated closure means perfect control *every time.* The drawing below shows why these valves are so often demanded for the flow control jobs where errors can't be tolerated . . . and why they make flow control foolproof on every service.

PERFECT, FOOLPROOF VALVE OPERATION


¼ turn for full opening or full closure.
Lubricant "cushions" plug for instant response.
Sealdport® pressurized lubricant sealing means *positive* shut-off.
Lubricant assures smooth, easy operation.

Rockwell-Nordstrom is the original and world's most complete line of lubricated plug valves with sizes from ¾" to 36" and pressures to 15,000 lb. Available at leading oil field and industrial supply houses everywhere. For details, see your supplier or write: Rockwell Manufacturing Company, Pittsburgh 8, Pa. If you live outside the U. S. A., write: Rockwell International Division, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

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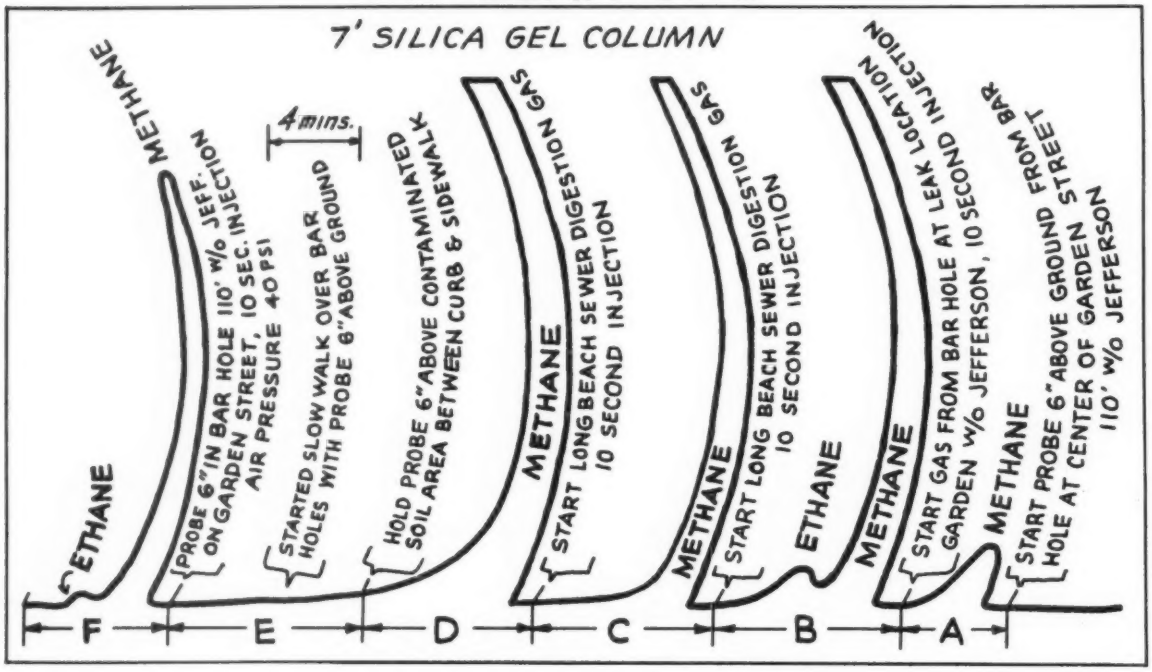
LEAK DETECTION & ANALYSIS FOR ETHANE AT LEAK SITE
7' SILICA GEL COLUMN
METHANE
ETHANE
4 mins.
PROBE 6" IN BAR HOLE 110' W/O JEFF. ON GARDEN STREET, 10 SEC. INJECTION AIR PRESSURE 40 PSI
STARTED SLOW WALK OVER BAR HOLES WITH PROBE 6" ABOVE GROUND
HOLD PROBE 6" ABOVE CONTAMINATED SOIL AREA BETWEEN CURB & SIDEWALK
METHANE
START LONG BEACH SEWER DIGESTION GAS 10 SECOND INJECTION
METHANE
START LONG BEACH SEWER DIGESTION GAS 10 SECOND INJECTION
ETHANE
METHANE
START GAS FROM BAR HOLE AT LEAK LOCATION GARDEN W/O JEFFERSON, 10 SECOND INJECTION
METHANE
START PROBE 6" ABOVE GROUND FROM BAR HOLE AT CENTER OF GARDEN STREET 110' W/O JEFFERSON
F
E
D
C
B
A

Fig. 6. Leak detection and analysis for ethane at leak site.

easily introduced and the test will be run automatically. After five minutes, another test can be made by simply inserting the probe in the same source or another source.

• Discussion of results

Figs. 4, 5 and *6* show clearly the separation of CH_4 and their related peak heights. Since no attenuator is available with this equipment, it was not possible to either reduce the methane peak or raise the ethane peak.

Fig. 4 is a run with the sample gas at atmospheric pressure accounting for the low peak of C_2H_6 on a 14-ft column. By increasing the pressure in the four-way sample side, it is easy to increase the size of the sample without increasing the volume of the sample size. Hence the number of molecules in the sample is effectively increased.

Fig. 5 is a run using procedure 1 with the sample gas in the four-way valve at 30 psig. It shows clearly the increase in peak height of ethane.

Fig. 6 shows several successive runs using a 7-ft silica gel column and procedure 2 under actual field conditions, as follows:

3A.)—Ten-second sample with probe 6-in. above 1-in. diameter bar hole containing about 20 per cent gas from known gas leak. Only methane is indicated.

3B.)—Ten-second sample with probe 6-in. in bar hole (same as in 3A). Both methane and ethane are shown.

3C & D.)—Ten-second sample from Long Beach Sewer Digestion tank containing 65 per cent methane, 35 per cent CO_2, 2 per cent H_2, and 3 per cent N_2. No ethane peak indicated.

3E.)—Attempt to pick up sample while walking about leak area with probe 6-in. aboveground —Negative.

3F.)—Same as 3B, showing effect of purging in bar hole.

Fig. 7 shows sewer digestion gas with no ethane as checked by Perkin Elmer Chromatograph with zero base line.

No attempt was made to get truly quantitative results. However, *Table 2* shows results of runs for 100 per cent, 75 per cent, 50 per cent, 25 per cent, 5 per cent, and 1 per cent natural gas and their related C_2H_6 peaks.

The curves in *Table 2* show clearly that the broad band infra-red combined with chromatographic sep-

TABLE 2.

Percent of Natural Gas	*Inlet Column Pressure*	*Seconds in Bar Hole*	*C_2H_6 Peak Height Division*
100	40 psi	5	4
75	40	5	3
50	28	5	2
25	35	25	1.5
5	35	30	.3
1	35	40	.1

aration can be a competent qualitative tool for the detection and distinguishing of natural gas from other sources of combustible gases and vapors. Under field conditions quantitative results are not possible other than to indicate roughly, i.e. within an estimate of plus or minus 10 per cent, the concentration of gas in an atmosphere. Small concentrations require greater quantities of sample. This can be easily supplied by increasing the sample inspiration time or by seeking out the point of top concentration.

Quantitative results might be possible if an electrically operated constant pressure compressor were available and a six-way valve were used so that larger sample sizes could be put into the gas stream. A four-way valve larger than the valve used would be too difficult to operate.

Possibly more important than the successful operation to detect ethane in a combustible mixture is the demonstration of a basic simple use of the broad band infra-red detector under laboratory conditions as a quantitative detector of components eluted from a chromatographic column. A search of the literature indicates that this is an original use. For example, to detect gases having absorption bans in the 2 to 16 micron wavelength region, it would only be necessary to fill the detector chamber (*Fig. 1*) with a mixture of all the gases that would be analyzed. No absorption cells would be needed nor would one have to scan trapped off samples.

The benefits, to the gas industry, and the public, of this development have already been felt in terms of more rapid detection and repair of leaks. ■

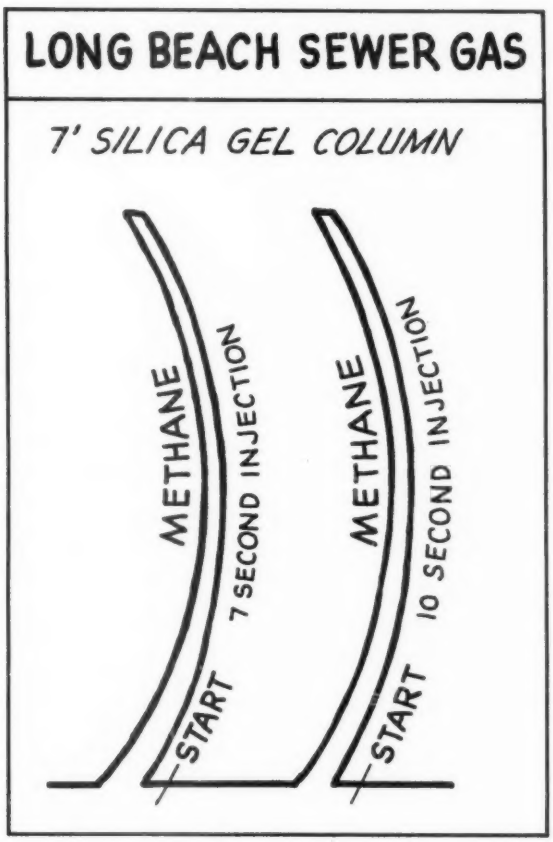

Fig. 7. Long Beach sewer gas—7-ft silica gel column.

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ACKNOWLEDGEMENTS

The basic concept of this thesis, namely the use of chromatography in conjunction with a positive broad band infra-red detector, seems simple enough after it is developed, but it could not have come about if it were not for the patient help and criticism of Dr. Alfred Vogel over the past years.

I would like to take this opportunity to express my appreciation to all of the staff of the Chemistry Department of Adelphi College with whom I have had the pleasure of associating, in particular Miss Thimm, Dr. Lowman, Dr. Bieber, Dr. March, and especially, Dr. Glickstein.

It was my assistant, Joseph Buonincountry, whose help in preparing equipment and setting up tests made it possible to have the leak detector on the road far ahead of the original completion date.

I also want to thank everyone in the Long Island Lighting Co. who listened to the trials and theories in conjunction with this work, sometimes for hours, in particular Adolph H. Wicht, S. W. Horsfield and Mr. Donald Cozzens.

Thanks to Doris Schepard for typing and preparing the text.

Last, but not least, thanks to my wife, Lois, for helping and encouraging me while taking evening courses for the past eight years. ■

A dissertation in the Department of Chemistry submitted as partial fulfillment of the requirements for the degree of Master of Science at Adelphi College, Garden City, L. I., N. Y.

View of engineering division office.

Top engineering division men make final design approval of new gas stops. From left: Walter J. Bowan, chief research engineer; Frank H. Mueller, vice president and director of engineering; John J. Smith, chief products engineer; and W. R. Leopold Jr., engineering division manager.

GAS staff report

By J. FRED EBDON, Editor

ONE of today's great challenges to the mind of man is keeping pace with its own creation. As he has diversified and refined his tools, machines and weapons, it is easy to see that creative thinking has adequately manipulated man's inherent capability.

Creative thinking has been stimulated as never before during the last two decades. One might say that it has progressed alarmingly, but it is not prudent to so style an advancement of knowledge.

Industry in general has been challenged to develop research and development capabilities to keep creative thinking and product progress in a happy relationship.

In recent decades, research and development have, along with engineering, become as important to the economic life of most industrial enterprises as the payroll. Some corporations have been reluctant to advance "R&D," as they have become quite popularly known, and have paid for this to a varying extent. Others have given these operations full access to corporation life and resources.

The gas industry has not been too slow in exploiting advantages available from research-engineering-development operations. Gas industry manufacturers have at least matched this trend.

To take a look at creative thinking in action and experience some realization of its result—product development—it was my pleasure to look in on these phases of the Mueller Co.'s operations in Decatur, Ill.

There, a new plant wing has been constructed to house the Mueller engineering division which includes, in addition to those functions, product development, research and several supporting operations.

While Mueller's new engineering building is not lavish in the same sense that some businesses doing extensive government financed R&D work are, it is very pleasing in concept. Mueller has produced an atmosphere compatible for originating and sustaining thought programs. Functional arrangement was the

Exterior view of engineering division building.

How engineering and research spur product development

prime consideration. The functional concept has been carried through to produce an extremely comfortable, large, well lighted place to work, meeting the measure of modernity for all considerations and besting it in most.

The chart of *Fig. 1* shows personnel and organization of the force that utilizes the modern 13,938-sq ft research-development-engineering facility. There are others to support these functions, but this illustrates the basic engineering set-up.

A prime objective of the people and physical plant is development of new products. Thus, creative thinking is invested to originate and prove design, production and quality of products. Here we have an example of how the mind of man is constantly striving to keep ahead in bringing to fruition tools and machines compatible with current technology and science. Such an operation is dedicated to the better way, the ideal material, and the ultimate in performance.

About 5 per cent of the engineering time at Mueller Co. is dedicated to basic research. This can be thought of as an apportionment for the benefit of science itself, rather than for direct improvement of products. This gives balance to the research function in line with the present state of industrial engineering research.

Some 50 people are busied with engineering operations in Decatur. This staff is, at the same time, headquarters for engineering functions at Mueller Co.'s plants in Chattanooga, Tenn. and Los Angeles. The staff is augmented by a limited (as required) utilization of consulting engineering and research agencies.

In addition to basic research, Chief Research Engineer Walter J. Bowan's section works on product improvement and development of new products. A planning committee meets once a week to bring up and consider ideas leading to all research section objectives. Once approved, the research section has the responsibility of designing and preparation of engineering drawings for a new product to a rather complete stage.

From there, the product section, headed by John J. Smith, takes over. Products section makes full sets of production drawings. The next step is production of prototype units for evaluation and test. This sec-

Test laboratory operator Tom Little (left) adjusts equipment used for cycling operation to test wear endurance of ductile iron Lub-O-Seal stop. Bowan and Binkley are examining test samples of ductile iron stops.

tion then follows through in production of the product. It also takes care of modifications to satisfy individual customer-company requirements, when necessary.

Engineering services section, under George F. Binkley as manager, maintains all engineering records, operates the model shop, and staffs test crews. Testers are trained by the engineering division.

The plan for the future, according to Vice President and Director of Engineering Frank H. Mueller, is to: (1) continue a program of obtaining more and more data relative to existing products, and (2) continue to increase the total research effort.

- **The test area**

An important part of the new engineering facility at Mueller—some 8352 sq ft, to be exact—is a test area. There, developed products are checked to establish design, materials and components. Engineers and testing technicians observe product issue to determine, through physical testing, if they are ready to meet the rigors of field tests.

Norman Wilcox (seated), test laboratory lead man, operates strain gauge equipment in control room of high pressure burst chamber. Chief product engineer Smith is viewing test parts through a fracture-proof window while test is in progress.

A highlight of the test facility is a high-pressure room. This is a vital unit for checking design in Mueller product development. It reminds one of a large, high-ceilinged cold storage room. The only unclosed opening is a long, narrow window which is adequately isolated from an observation chamber by inches of quartz-glass.

Pipe and headers permit connection of both large and small products. Services supplied to the high pressure testing room are 30,000 psig water and 3000 psig air.

In this room products from the smallest up to even 12-in. valves, line stopper fittings, etc., are pressured and over-pressured to the point of failure. Strain paint and strain gauges—feeding data into instrumentation located in the observation room—are employed during pressuring work. These data augment visual observations during the products paths to destruction.

Provisions are made so that pressuring media can be cycled, thus revealing performance under pulsating flow.

Another interesting room in the test area is an instrument room. Here various non-destructive test instrumentation is kept, maintained and operated. Typical is a comparator which gives a visual magnification of thread forms, teeth, etc., for examination and measurement.

A specially designed, custom-built electronic instrument measures taper, concavity, convexity, waviness, etc., of valve and stopcock keys, bores, bodies, etc. It produces measurements accurate to one ten-millionth of an inch.

Further into the test shop, plastics materials used for fittings or parts and assemblies of various other Mueller products are tested in a temperature-humidity cabinet. Naturally, other materials may also be subjected to these controlled atmospheres as needed. The cabinet can be set to hold selected values up to 150 deg F and 90 per cent relative humidity.

Facilities are available to apply cycling series to valves and stops. One unit mechanically and automatically cycles stops from fully-open to fully-closed and return. In this unit, the stop under test is installed on piping mounted underwater. The flowing fluid is compressed air—at 350, 500, 750 psig, as set by test specifications from the engineering division. Thousands of cycles are then run and counted, while the stop is observed periodically for leakage.

Another valve or stop cycling unit uses water as the testing fluid. It cycles valves against water flowing at 135 gpm at up to 500 psig. An open pipe downstream permits observation of a positive stop as the valve goes through its swift sequence of cycles.

More conventional, though none the less vital, test machines and assemblies place products under bending moments, compression loads, torques, tension tests, etc. All in all, it is a complete test shop designed to assure that products will deliver the design built into them. Thus, field performance can be predicted and results of field abuse evaluated before a product goes into final production.

As it happened, a new product developed under the expanded engineering and research concept at Mueller was at hand. It was practical, then, to study the

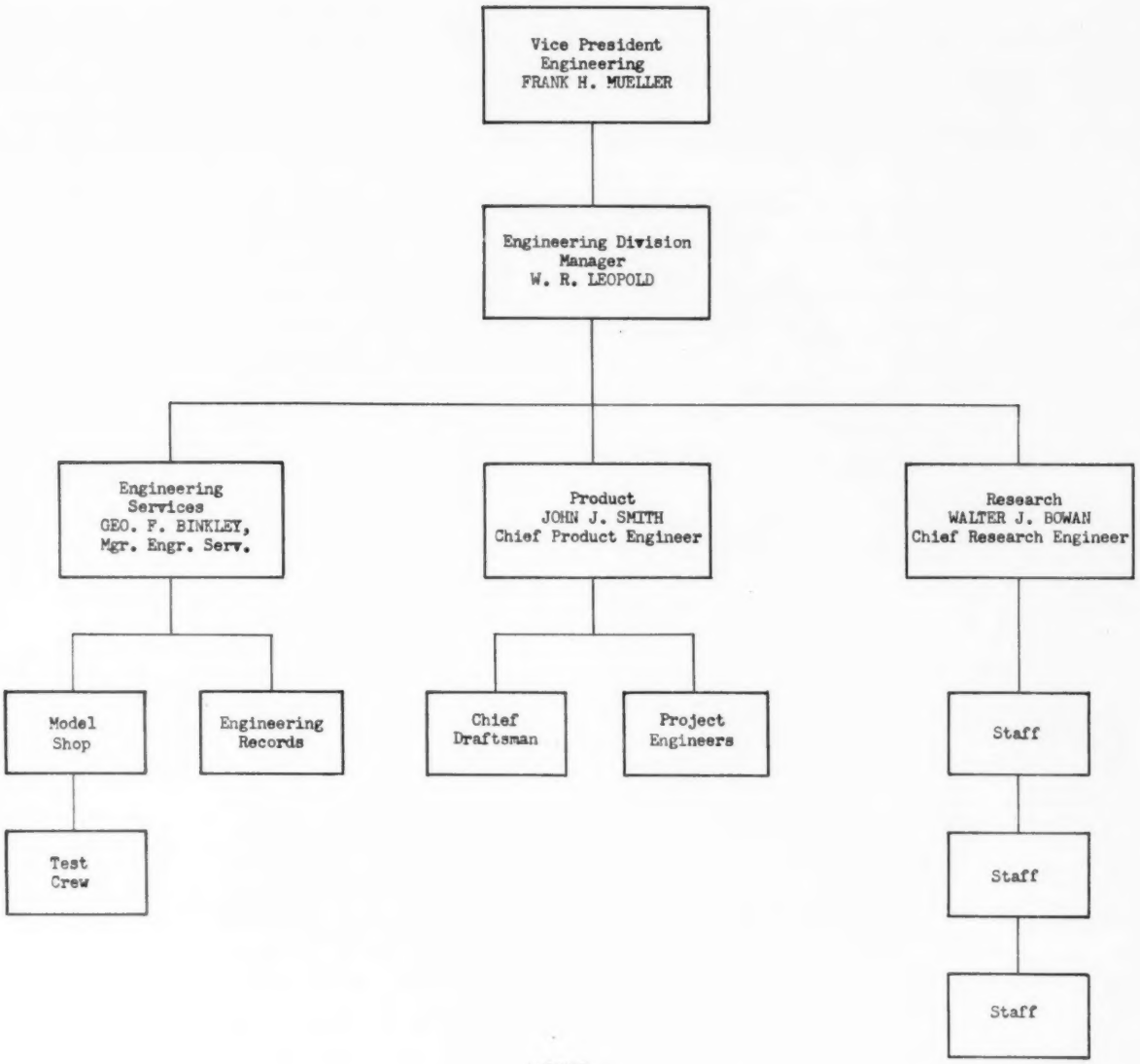


FIGURE 1.

path of this product as an illustration of the fruits of an increased engineering program.

For some years, the Mueller Co. has had a Lub-O-Seal stop in varying sizes carrying a 125-psig rating. Field reports were brought to the research planning committee indicating the gas industry needed a 250 psig rating on a similar stop.

Initial investigation showed that it was just as practical and economical to design and produce a 500 psig stop. So, that was selected as the objective.

The following factors were necessarily considered in developing this new product:

1. *Material.*

2. *Seals*—had to be the rotating type and able to seal under 500 psig.

3. *Lubricating system*—had to hold grease in the system under the rated pressure.

4. *Grease entrance*—had to keep grease in for a minimum of five years.

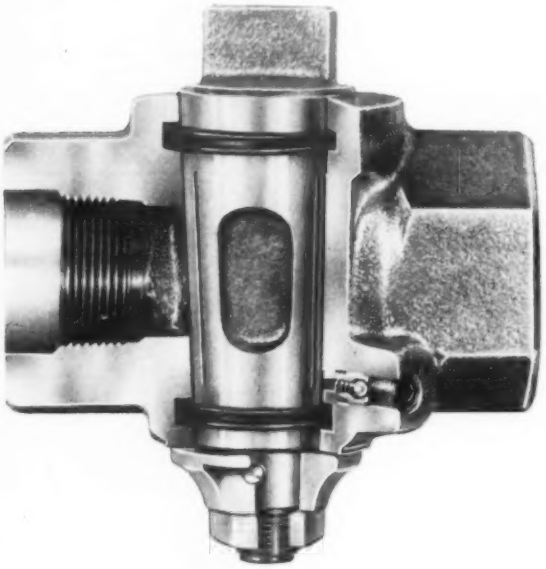
Research investigated various materials. A relatively new one—ductile iron—was selected. Actually, Mueller has had a 500 psig ductile iron stop on the market since November 1958—but in the 1¼-in. size only. This project was to develop units in the complete range of sizes from ¾ in. through 2 in. Lockwing models were to be developed in the ¾- and 1-in. sizes.

Ductile iron is only a comparatively new material. It was developed by the Bayonne (N.J.) Laboratories of International Nickel Co. during the early part of World War II. It is a material having the casting and process advantages of cast iron with resulting physical characteristics for parts and products of those of cast steel. Arrangement of graphite flakes in gray cast iron gives that metal its brittle charac-

teristics, while in ductile iron graphite carbon is in spherical form to produce a base metal that is much more continuous. Therefore, it has physical characteristics much like steel or malleable iron.

Mueller researchers chose ductile iron because it is:

1. A very homogeneous material.
2. Readily machineable.
3. Excellent for producing pressure-tight castings.
4. High in modulus of elasticity (Young's modulus) and displays good rigidity.
5. Corrosion resistant—as are most cast materials in comparison to wrought.



Lub-O-Seal high pressure ductile iron meter stop with recessed ends (¾ in.).

On the other hand, good ductile iron is pretty critical to make. But a source for a fine material was located. And there have been discussions about pressure ratings with ductile—some say it is equal to but 80 per cent of that for steel, while others rate it at 100 to 100 plus per cent equivalent of steel for valves.

For pressure castings, though, ductile is ideal and a great advantage is its characteristics that produce pressure-tight castings for very odd shapes.

With the material selected, the design approach was next considered. The taper of key and bore used in Mueller stops has been proven through the years. They were retained in the ductile 500-psig product. The same applies to the tamper-proofing design and components.

Sealing the lubricant inlet was accomplished by use of a ball-check grease fitting. A socket-head pipe plug completes the seal. The grease system is cut off or sealed by locating the port so that a ground and lapped seating surface is between it and the main gas port. This prevents leakage.

The top and bottom of the key are sealed with "quad-rings." These were found effective for a positive seal. Conventional O-rings did not do the job under rotative motion and 500 psig. The quad-rings pressurize the lubricant—deflecting as the lubricant reservoir is filled and expanding to keep pressure on the lubricant as it is used.

Sealing design is, of course, important in keeping the stop operative under conditions of minimum maintenance. The Mueller valve is designed with a grease reservoir and feedback, while, as described, sealing uses the grease energy.

Following design, casting and machining, assembly, etc., the experimental stop was sent to the testing shop to see what it would do under extremes. In the high-pressure room, for example, the stop was tested under pressure (both static and pulsating). As they took the stop up, a reducing coupling blew out at 9500 psig. No leaks on top or bottom of the key could be detected. They next submerged this same stop in water and applied 500 psig air pressure, with the stop closed. Still no leakage at key ends and only negligible port leakage was recorded. In another high-pressure test, they were finally able to blow the key out of the body—at 15,000 psig.

A bending test put a bending moment of 18,000 in.-lb (4000-lb load) on the stop. The Sch. 80 steel pipe connections bent 2.83 in. out of alignment, but the Lub-O-Seal stop remained intact. Then, a compression load of 26,200 lb was applied. Again, the pipe (Sch. 40, this time) let go first. Pipe was badly distorted and the pipe threads were stripped. Next it was torsion—and again the Sch. 40 pipe failed. And it was the same story during the tensile test. The Sch. 40 pipe holding the valve experienced failure in the threaded section at 22,150 lb of tensile pull.

After each of the physical tests detailed above, the stop was subjected to air pressure at 500 psig under water. In each case the ductile iron stop was absolutely tight in the closed position and there were no leaks at the top or bottom of the key.

A rugged cycling test was passed by the new Mueller stop. They cycled it—fully closed to fully opened, etc.—1000 times at 750 psig under water. No leakage was observed. And this was followed with several regreasing tests involving operation with the valve open, closed, on the line under 500 psig pressure, etc., to duplicate every possible field possibility. They couldn't make the lubrication system mis-perform.

So, convinced in their own minds that they had a product of which they could be sure of, the Lub-O-Seal 500 psig class stop is being placed on the market. It is fabricated (both key and body) from ASTM 60-40-15 ductile iron, with minimum physical requirements of:

Tensile strength	60,000 psi
Yield strength	40,000 psi
Elongation in 2 in.	15 per cent

This, then, has been the story of how one company uses engineering research and development supported by modern plant and equipment to bring new and improved products to the gas industry. ■

Students in Washington Gas Light's service training school dismantle gas refrigerator Ice-maker units under direction of Staff Assistants Bill Norton (left) and Guy Tuel (right).

How to deal with absorption refrigeration

During their first four years in the service department, employees of Washington Gas Light Co. are given the training outlined by this course on gas-fired, absorption refrigeration.

By G. R. THOMPSON,

Training Supervisor, Service Department
Washington (D. C.) Gas Light Co.

TO reduce the need for specialization, thus making servicemen more versatile and efficient, service personnel of Washington (D. C.) Gas Light Co. are given thorough training in gas-fired absorption refrigeration.

The program is supplemented with operating instructions in Washington Gas Light's "Service Handbook," practical demonstrations during an annual customer relations program, and service hints posted at each service center.

Training aids used in the refrigeration school are:

1. Several complete gas-fired refrigerators.
2. Refrigeration units mounted on platforms and connected to a gas supply.
3. Thermostats.
4. Burners.
5. Door gaskets.
6. Ice-maker assemblies.
7. Easels containing flip charts.
8. Slides (35 mm) relating to units and controls, cabinet maintenance, and automatic Ice-makers.

A brief history of the gas refrigerator is given. It is explained that the gas-fired absorption cycle—something of a miracle in refrigeration—originated as an invention of two Swedish students, Carl Munters and Baltzar Von Platen. American rights were acquired by Servel Inc. from the Swedish Electrolux Corp. many years ago. The Whirlpool Corp. recently purchased these rights from Servel.

• The refrigeration unit

By way of introduction, servicemen are told that the unit consists of a number of steel vessels and pipes welded together to form a hermetically sealed system. The entire unit is at the same total pressure since all parts are in communication. All lines through which liquids flow are graded to facilitate gravitational movement.

The refrigeration unit is charged with: (1) ammonia, as the refrigerant; (2) water, as the absorbent solution; and (3) hydrogen (a gas). The hydrogen furnishes the initial pressurization for the unit to a value high enough to assure liquefaction of ammonia vapor in the condenser at normal room temperature. It also makes vaporization of liquid ammonia possible in the evaporator and serves as a conveyor for ammonia vapor from evaporator to absorber. A reserve volume of ammonia within a vessel enables unit pressure to be increased when condensing ammonia vapor is retarded by poor air circulation or high room-air temperatures.

Some basic facts about the refrigeration unit charges are important. First, ammonia boils at a lower temperature than water under any conditions. Second, ammonia mixes readily with water, but hydrogen will not mix or dissolve in water. Then, ammonia readily evaporates when exposed to an atmosphere of hydrogen gas, due to differences in densities.

• The simple absorption cycle

While the instructor is explaining the simple absorption cycle, a unit diagram (see *Fig. 1*) is used. Each component and flow cycle is treated individually.

Generator—A small gas flame furnishes the energy (heat) to heat the aqua-ammonia solution in the generator. This drives off ammonia, as vapor, and slugs of water through the vapor-liquid lift tube to the separator.

Separator—in the separator, ammonia vapor and slugs of water separate. Water (absorbent solution) falls to the bottom of the well. From there, it flows by gravity through a liquid heat exchanger to an absorber. Ammonia vapor rises to the top of the separator and flows down through a vapor tube to a submersion analyzer.

Submersion analyzer—Ammonia vapor bubbles through the aqua-ammonia solution which is on its way from absorber to generator. This washing process removes water from the ammonia vapor before it enters the ammonia-vapor rectifying line.

Ammonia-vapor rectifying line—Two things are accomplished by a finned section on the ammonia-vapor line, and clamping the vapor line to the unit frame. First ammonia vapors are precooled prior to entering the condenser, and, second, there is a final removal of water vapor.

Sessions like this produce a "voice mirror." With the aid of a tape recorder, servicemen can hear what they sound like after acting out an imaginary dialog between gasmen and customer.

It should be noted that servicemen will occasionally loosen the clamps which hold the ammonia vapor line, to eliminate a ticking noise that may be experienced due to expansion and contraction. Loosening these clamps will cause hot ammonia vapors to occupy 10 to 25 per cent more of the condenser, thus reducing unit efficiency. Sheet lead may be placed between clamps and the ammonia line if necessary. This will eliminate such noise.

Condenser—In the condenser, ammonia vapor is liquefied by heat transfer from the refrigerant to room air which sweeps over the finned section. Liquid ammonia then flows by gravity to the trap between the condenser and evaporator.

Evaporator—Liquid ammonia gravitates through the evaporator. It is exposed to a hydrogen atmosphere which is countermoving, upward. The ammonia flashes from liquid to vapor in the presence of this hydrogen "breeze." Expansion through evaporation removes heat (heat of vaporization) and reduces evaporator surfaces to a very low temperature.

Rich hydrogen gas circuit—Hydrogen—containing cool ammonia vapor—leaves the top of the evaporator and passes down through the rich gas tube to the absorber.

Absorber—In the absorber, hydrogen and ammonia vapor move upward. They contact absorbent solution on its return from the separator. Water absorbs the ammonia from the hydrogen. The resulting aqua-ammonia solution collects in the absorber bowl. Free hydrogen leaves the top of the absorber through the weak gas tube and returns to the evaporator. The absorber is finned. A cooling effect from room air removes heat generated as ammonia dissolves in water.

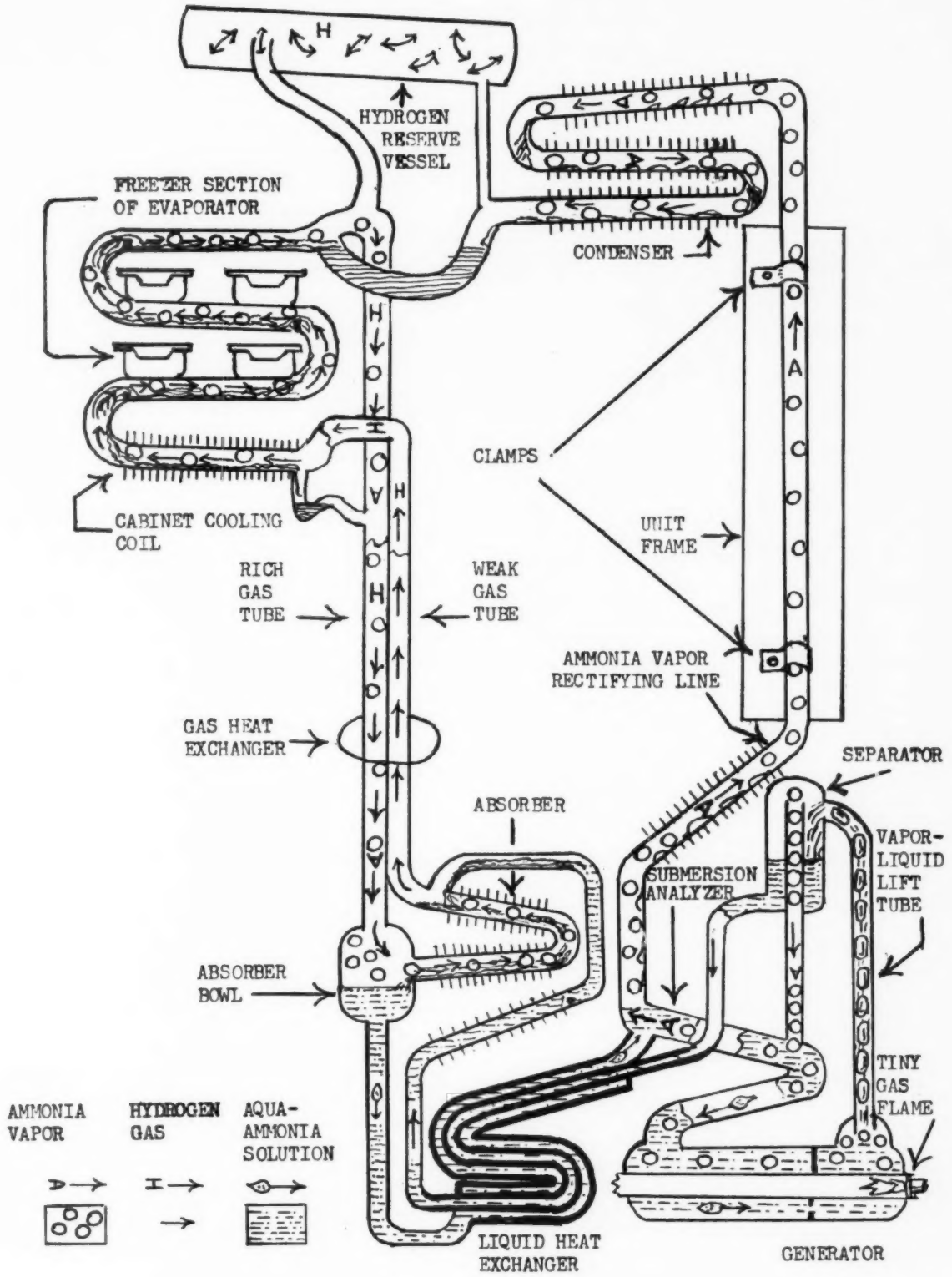


Fig. 1. Unit diagram.

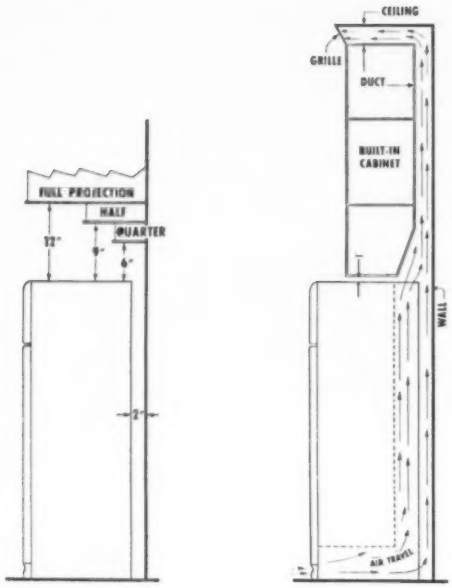
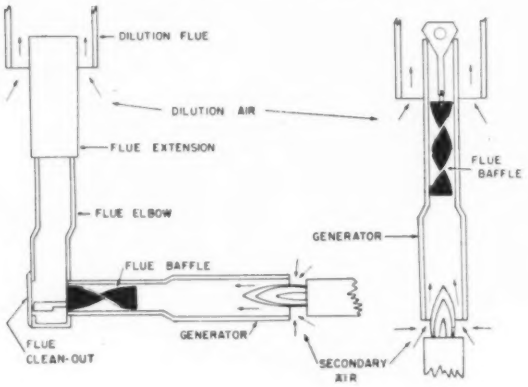


Fig. 2. Recommended minimum clearances for assuring adequate air flow around gas-fired absorption refrigerators.

Fig. 3. Flue system for gas-fired refrigerators.



Gas heat exchanger—Two contacting vertical tubes make up the gas heat exchanger. One contains heavy, cool, rich gas, and the other light, warm weak gas. Heat is removed from the warm, weak gas before it enters the bottom of the evaporator; thus, the refrigeration effect is improved. Continuous circulation of hydrogen between evaporator and absorber is maintained by the differences in weight of gases in the two vertical columns.

Liquid heat exchanger—The liquid heat exchanger is an economizer. It precools the hot, absorbent solution entering the absorber. At the same time—through the heat exchange—it preheats the aqua-ammonia solution returning to the generator. Efficiency of absorber and generator are thereby improved.

Hydrogen reserve vessel—This vessel is connected between condenser outlet and rich gas tube. At any time the condensation of ammonia vapor is retarded —due to poor air circulation or high air temperatures —the reserve hydrogen is forced out into the active part of the unit by a surplus of ammonia vapor occupying the hydrogen reserve vessel. This causes an increase in unit pressure and facilitates condensing of ammonia vapors at higher temperatures.

• Practical demonstrations

During coverage of the outline for the gas absorption cycle, an operating refrigeration unit is used to demonstrate important points. For example, students feel ammonia condenser flow lines before and after clamps are removed or loosened from the ammonia vapor rectifying line.

Then, air circulation is stopped by placing paper over the condenser coils. The students feel the condenser outlet and hydrogen reserve vessel before and after this action is taken.

Importance of the unit evaporator being properly level is demonstrated by elevating the absorber side of the unit to stop liquid flow in the condenser and absorbent solution line. Hydrogen circulation is stopped by tilting the unit to form a liquid ammonia seal in the evaporator. (Unit is checked for level, front-to-back and side-to-side by placing a spirit level in the evaporator or frozen food compartment.)

The importance of minimum clearances to maintain good air circulation are stressed. Minimum recommended clearances are illustrated in *Fig. 2*.

• Changing unit

The class actively participates in changing-out units. Emphasis is placed on:

(1) Replacement of freezer compartment gasket.
(2) Sealing of any other unit openings to avoid air leaks.
(3) Installation of old flue baffle in replacement unit if the latter is not so equipped. Omission of the flue baffle will cause unit to be 10 per cent to 26 per cent undergassed.
(4) Replace rear unit panel to assure proper air circulation between absorber and condenser.

• Cleaning the refrigeration unit

The best methods for cleaning a refrigeration unit with a vacuum cleaner or wet flue brush is detailed. Cleaning the burner, flue-way, controls compartment, absorber, and condenser fins is detailed. The importance of a clean and properly adjusted flue system is demonstrated by (refer to *Fig. 3*):

(1) Partially obstructing the flue system.
(2) Loosening the flue clean-out.
(3) Installing the flue extension out of the dilution flue.

At this time, Washington Gas Light's standard

practices for disconnecting refrigerators ahead of shut-off valve, checking refrigerator flue systems, and correct burner positions are reviewed with the class.

• Visual aids

Some 27 35-mm slides are brought into play in the course at this time to aid full understanding of:

(1) Units.
(2) Burners and their component parts.
(3) Cleaning and adjustment of burners.
(4) Btu input ratings and orifice selection.
(5) Setting maximum and minimum pressures with a manometer.
(6) Installation and adjustment of gas thermostats, including testing.

• Operating instructions

Using appropriate references from WSG Co.'s Service Handbook, the class participates in the following steps leading to a thorough understanding of operating characteristics of the gas refrigerator:

(1) Disassembling, cleaning and reassembling burner.
(2) Selection of Btu input for several refrigeration units, from 1934 through current year models.
   1. Selection of burner, orifice, turbulator, maximum and minimum flame pressure settings. (We now use the three type "C" square die cast burners.)
(3) Setting of initial pressure at 3.5 in. w.c., using spring loaded, and dead weight regulators.
(4) Setting maximum and minimum flame pressures using two methods of adjusting maximum pressure.
   a. Maximum flame pressure setting is made at burner adjusting screw when thermostats other than model No. 5471-86 are used.
   b. Maximum flame pressure setting is made at adjusting screw provided in the model No. 5471-86 thermostat.
   c. Minimum flame pressure setting is made at adjusting screw provided in all thermostats.
(5) Practice in spacing of burner, between end of air shutter barrel and front end of generator, on front-to-back, side-to-side, and vertical generators. Also alignment of burner with generator to avoid flame impingement.
(6) Positioning heat conductor in relation to burner cap, and testing burner safety valve.
(7) Method for checking and correcting unstable minimum flame.
(8) Changing thermostats and cables, including practice in rewinding thermostat cable.
(9) Cleaning thermostat valve and seat on thermostats equipped with clean-out cap.
(10) Testing the following thermostats using salt and ice solution, and pocket thermometer.
   a. Model No. 5471-80, semi-automatic or manual defrost type.
   b. Model No. 5471-87, semi-automatic defrost type.
   c. Model No. 5471-77, manual defrost type.

NOTE: The above thermostats are used as replacements on refrigerators manufactured prior to 1947.

   d. Model No. 5471-86, manual defrost type thermostat which has been used on all refrigerators since 1947.

NOTE: Calibration of thermostat is covered where applicable.

Following the class participation exercises on operating characteristics, 20 35-mm slides are shown covering:

(1) Sealing cabinet shell.
(2) Installation of cabinet liner and trim.
(3) Testing for air leaks.
(4) Adjustment of hinge, striker and latch assemblies.
(5) Installation of door gaskets.
(6) Alignment of cabinet doors.

The class then puts these factors to use by testing gasket door seal with a dollar bill; placing a light bulb in the cabinet; adjustment of hinges, etc.; installation of door gaskets; and alignment of cabinet doors. In line with this, a review of standard procedures for analysis of defective units on gas refrigerators and operation analysis from the Service Handbook are reviewed with the class.

The next subject for study is the automatic Ice-maker. This is handled with 39 35-mm slides relating to:

(1) Automatic Ice-maker component parts.
(2) Installation and adjustment of Ice-maker parts.
(3) Step-by-step diagram of a complete operating cycle for the Ice-maker.
(4) Testing Ice-maker components.

During a practical demonstration of the Ice-maker cycle, which follows the slides, appropriate references from the Service Handbook are reviewed.

Servicemen who will be engaged in parts repair work are given further, intensive training in removing and repair of component parts, and testing and adjusting.

The service policy at Washington Gas Light Co. relating to gas refrigerators is interesting. There is no charge made for:

(1) Investigating customers' service requests.
(2) Adjusting burners and controls.
(3) Cleaning air-ways and flue when it is necessary for efficient operation.
(4) Locating and repairing gas leaks where no material is required.

There is a charge for replacement of parts after the first year's warranty has expired. This is a labor charge. Both labor and material are charged for after the full warranty period has passed.

Work involving installation and repair to water and gas piping is referred to the customer's plumber. ■

GAS · DISTRIBUTION NEWS

ASA adopts new appliance standards

Twenty-two AGA-sponsored gas appliance approval and accessory listing requirements have been approved as American Standard by the American Standards Association.

One of the standards covers gas-fired absorption summer air conditioning appliances. Approval of "American Standard Approval Requirements for Gas-Fired Absorption Summer Air Conditioning Appliances" permits AGA Labs to test and certify these appliances for the first time under the industry's appliance approval program.

Extensive revisions to the American Standard Z21.30 were made and approved. This third edition is titled "American Standard Installation of Gas Appliances and Gas Piping, Z21.30-1959," thus dropping the term "in buildings."

Z21.30-1959 includes appliance and piping installations using undiluted liquefied petroleum gases, heretofore excluded.

Also made were extensive revisions covering venting and requirements covering air for proper combustion. Text includes provisions covering outdoor installation of gas equipment.

A provision is incorporated in the domestic gas range category specifying that top burner pilot flames are not to be extinguished by concussion. For the test, a standard test utensil with 5 lb of water is dropped 2 in. onto the top burner grates directly over each burner.

Revised requirements covering built-ins generally parallel those for free-standing ranges. However, built-in provisions include requirements for testing open top broilers for which there was no previous coverage.

Revisions also were made for central heating appliances, clothes dryers, counter appliances, deep fat fryers, duct furnaces, hotel and restaurant ranges, hot plates and laundry stoves, incinerators, portable gas baking and roasting ovens, room heaters, unit heaters, and water heaters. In the accessory field, revised tests are applicable to domestic gas conversion burners, manual gas valves, and metal connectors for gas appliances.

Additional information on the standards is available from the AGA Labs, 1032 E. 62nd St., Cleveland 3, Ohio.

Jazzman and restaurateur Eddie Condon tries his hand on "Condon's Magic Casserole." Magic Chef gas range is installed in Condon's Rumson, N. J., home, which will be featured as part of the redecorating picture story in the December issue of "Living for Young Homemakers." Daughter Maggie co-pilots the proceedings and named the family favorite, a combination of scalloped potatoes and Vienna sausage.

Girdler and C&I combine

Girdler Construction of Louisville and Chemical & Industrial Corp., Cincinnati, are combining their activities and facilities. Chemical & Industrial will be the parent with Girdler as a subsidiary. Both design, engineer, and construct processing plants for the natural gas, chemical, petroleum and other industries.

Consolidated launches new growth program

Consolidated Natural Gas Co. has set up a new department to aid its subsidiaries in the development of their industrial markets.

Energetic action to bring new industries into its service area and increase future gas sales is the key factor in Consolidated's growth program.

Heading the market development program is Christy Payne, Jr. He formerly was vice president of Peoples Natural Gas Co., Consolidated subsidiary.

In addition to Peoples Natural, the program will benefit East Ohio Gas Co. and Lake Shore Pipe Line Co., Cleveland; New York State Natural Gas Corp., Pittsburgh; Hope Natural Gas Co., Clarksburg, W. Va., and River Gas Co., Marietta, Ohio.

Weapon for fighting municipals available

The growing threat of municipal ownership of gas distribution systems is being met with a new and useful information tool.

The "Preparedness Kit for Municipal Gas Utility Elections," is part of the PAR Public information program. It contains a concise, clearly written guide on election procedure. Examples of different information materials used in an actual election are included.

The new kit is for use by companies facing franchise or revenue bond campaigns and for long range use in familiarizing staff personnel with electric campaign problems and special public information methods required.

Government - owned gas systems now total 566 in 34 states.

Lake Erie well plugged

Workmen plugged a well drilled in Lake Erie after an unsuccessful attempt to find natural gas. This was New York State Natural Gas Corp.'s second offshore well. The first, drilled last year, had an open flow of 200 Mcfd.

The second hole was drilled near North East, Pa., to about 4740 ft before the effort was stopped.

The company plans to drill another well next spring. However, it hasn't decided whether to locate in the same tract as this year or try near where the first successful well came in.

Cambridge Gas servicemen go back to school. Supervising proceedings are Class Instructor James Kneeland (standing at left) and Supervisor Fred Phillips (standing at right).

Cambridge Gas has new service school

Cambridge (Mass.) Gas Co. has set up a new, highly flexible school for servicemen. Two years of planning went into the books before the school was officially launched.

It is designed to teach the intricate terms of reference and service problems connected with the many new gas appliances on the market.

All the latest teaching methods and techniques are used with the most modern equipment available. All types of heating and air-conditioning systems—and their adaptations found in the field—are in operation. Controls, circuits and wiring schematics are mounted on pegboard panels. Simple, easy-to-read charts and diagrams are displayed. Films and slides, together with lectures and live demonstrations, make the school practical and effective.

Flexibility is stressed. With quick changes in "backdrops" and scripts, subject matter can shift from heating to the more specialized realm of air conditioning—or to the complicated details of other appliances.

The school is large enough to take care of a major segment of the Cambridge service crew. It presently operates on a rotating schedule, training six men for four hours a day until each has been instructed thoroughly on a given subject.

Periodic tests are given so that progress may be measured and adjustments in the courses made when needed.

The program is under the overall direction of Service Manager Fred Phillips. Instructional responsibilities are directed by James Kneeland, assistant service foreman.

Both veteran and new servicemen participate in the school.

Companies argue over Virginia territory

Counsel for the Washington (D. C.) Gas Light Co. told the Virginia supreme court that Virginia Gas Distribution Corp. is pursuing a "dog-in-the-manger policy" with respect to disputed service territory in northern Virginia.

Both firms are appealing a decision that divided the northern Virginia area between them. The State Corporation Commission made the ruling last year.

Washington's representative said Virginia Gas wants to extend service only where it can make the most profit. And, it wants to prevent any rival from giving improved service in large areas of Prince William and Loudoun counties.

A Virginia Gas spokesman countered that his company is under no obligation to provide service where it is uneconomical. He argued that it would not be in the public interest to give the disputed area to Washington because its rates are 42 per cent higher.

If the commission is upheld, Virginia Gas will keep the Chantilly airport area near Herndon, along with its Manassas, Dumphries, and Quantico Marine base customers. Washington would have service rights throughout Fairfax and Prince William, together with most of Loudoun county.

Virginia Gas asked the court to affirm its territory, but said the area not now served by either company should remain unassigned. Washington insisted it is willing to enter most of the area now.

Superior becomes division of Neptune Meter

Superior Meter Co., Inc., has been merged into the corporate structure of Neptune Meter Co. Superior formerly was a wholly owned subsidiary.

Walter H. Sieger, until now president of Superior, has been named a vice president of Neptune and will act as general manager of the new division.

In the change of status, the organization becomes the Superior Meter Division of Neptune Meter Co. Products, including gas meters, meter parts and accessories, which are made at the Brooklyn factory will continue to be sold under the "Superior" trade name.

A-C pumps unload LNG

Three Allis-Chalmers pumps were used to unload liquefied methane (at 250 deg below zero) from the first freighter to carry this product overseas. The 14-by-8 CDV-3 pumps are rated at 400 gpm, 65-ft head, 580 rpm.

The pumps are mounted on the deck of the Methane Pioneer and reach down 39 ft to the bottom of the storage tanks. They are driven by A-C vertical 10-hp, 580-rpm motors. Pump discharge is at deck level. So far, three 33,000-bbl loads have gone from Lake Charles, La., to England.

Crane expands in East

Crane Co., Chicago, has acquired all properties and assets of the Chapman Valve Manufacturing Co., Indian Orchard (Springfield), Mass.

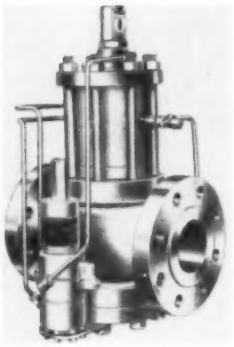
The move gives Crane eastern manufacturing facilities which it has not had since 1941 when it sold its Bridgeport, Conn., plant.

More News on page 97

GAS DIGEST

New Products and Trade Literature

For more data on any of these items use the Readers' Service Card on pages 89, 90

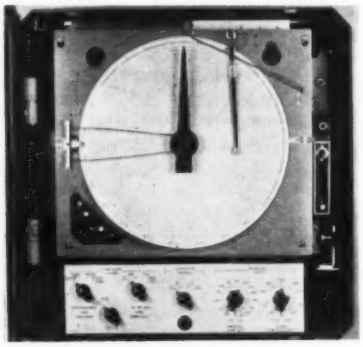


1. High pressure regulator

Fisher's new high pressure regulator features tight shutoff on 1000 psi pressure drop and an extreme range of accurate flow control. Type 403 is a piston-operated, single-port, high pressure reducing valve. Its discs and high pressure pilot are ideal for town border stations and compressor stations.
Fisher Governor Co.

2. Pumps

Jaeger's intermediate and heavy 3-in. contractors pumps permit quick removal of the entire suction chamber and liner plate without removing the volute. Adjustment, rotation, or replacement of the liner is completed in a few minutes. Higher performance is also offered.
Jaeger Machine Co.



3. Telemetering system

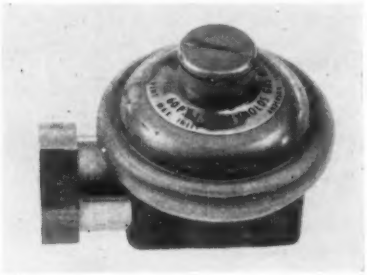
Bristol's computing telemetering system for distribution and pipeline uses is designed for corrected flow measurement. It consists of Dyna-Servo flow transducer and pressure transducer, a totalizing computing and transmitting instruction, and pulse-width to pulse-count transducer type integrator with counters.
Bristol Co.

4. Thread tape

Easy application of "ttp" thread tape speeds assembly of leakproof threaded pipe joints for plastic pipe. The new tape comes in ½-in. by 520-in. rolls, enough for 200 1-in. pipe joints. It is made of duPont's chemically inert Teflon.
Tube Turns Plastics

5. Washer-dryer

A self-cleaner and wash 'n wear cycle features Norge's new automatic combination gas washer-dryer. Cleaner power rinses the interior of the cylinder, automatically aerating and removing wash residue. Lint collected on a specially designed lint screen during drying cycle is washed down the drain in the next washing cycle.
Norge Division

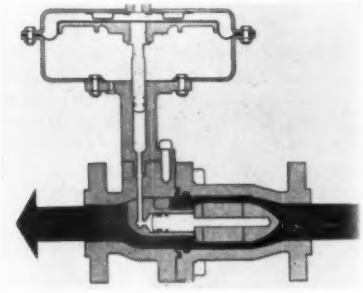


6. Gaslight regulators

Two new appliance regulators are designed especially for use in outdoor gas lights. Reynold's new regulators are the NR-⅛ for ounce-to-ounce regulation and the NRB-⅛E, for psi-to-ounce regulation. This is believed to be the first regulator of this size to offer psi inlet pressure.
Reynolds Gas Regulator Co.

7. Portable power

A new piece of motive equipment soon may provide mechanical convenience and power-house utility to many pipeline-laying operations. The combination utility unit was originally conceived as a vehicle to serve jet airliners. It is described as a power-packed self-propelled generator set that can take itself anywhere an ordinary vehicle can go—without need of tying up a second vehicle to pull it. It may be equipped with an electric welding machine for field repairs or laying pipe.
Stewart & Stevenson Services



8. Pressure reducer

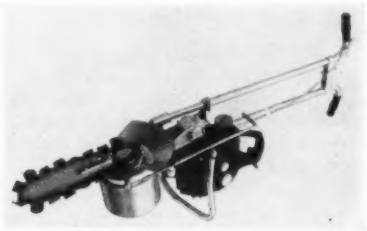
A new pressure reducing gas regulator for gas lines features straight-through (laminar) flow and positive shutoff. Apco's Jet Stream regulator eliminates jetting of high speed gas and transient particles into the side of the regulator. The smooth, straight-through flow also reduces sound vibration. Its hydraulically actuated slave piston regulates flows with extremely fine control. Jet Stream can be regulated from full flow to bubble-tight shut-off in three seconds.
Apco Division

9. Odor filter

American Air Filter has a new disposable activated carbon odor filter. It combines high efficiency odor removal with a high degree of air cleaning in one disposable-type unit. It can be used in almost any situation where contaminants in vapor form should be removed from an enclosed space.
American Air Filter Co.

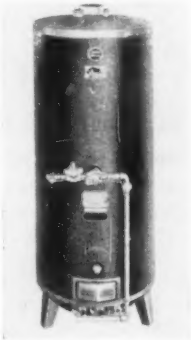
10. Ductile iron stop

Mueller has added a Lock Wing model to its new line of 500-lb ductile iron Luboseal stops. The new line now consists of the H-1180 solid flat head stop in ¾-, 1-, 1¼-, 1½-, and 2-in. sizes and the H-11185 lock wing stop in ¾- and 1-in. sizes. Working pressure of the new stops is 500 psi.
Mueller Co.



11. Trencher

Trenchsaw is a new tool for rapidly cutting a 1-in. wide trench to variable shallow depths as required for the laying of pipe. Because of the small amount of dirt removed from the narrow trench, it is easily backfilled with a garden rake. Trenchsaw is powered by a portable chain-saw engine which can be detached and used separately.
Auburn Machine Works Inc.

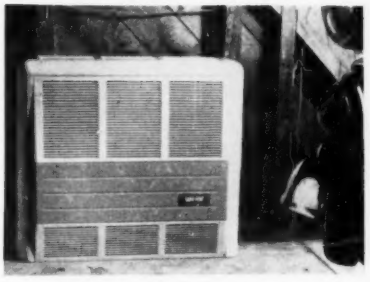


12. Water heater

John Wood's new line of Hi-Volume commercial automatic glass-lined gas water heaters is available in circulating or storage models. Circulating types—with multiple flue construction—are for use with large storage tanks where large amounts of hot water are needed. The storage types are for domestic and light commercial uses that have above-average hot water needs.
John Wood Co.

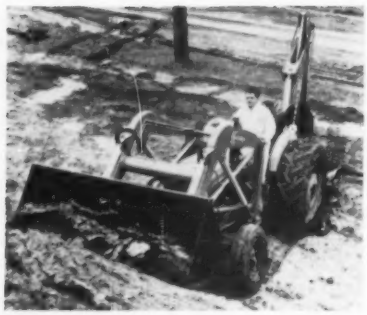
13. Power shift

A power shift transmission, featuring a new concept in the transmittal of pipelayer power, is available on Caterpillar's No. 583 pipelayer. On the operator's deck, one speed-range selection lever takes the place of the three levers controlling gear selection, flywheel clutch operation, and forward-reverse movement.
Caterpillar Tractor Co.



14. Garage heater

What is said to be the No. 1 cause of emergency automobile calls can be reduced with gas heat. According to the American Automobile Association, battery and electrical failures are the driver's most frequent motoring problems. H. C. Little's sealed gas heater is suited for garage heating. It heats independently from the home heating plant, may be controlled by thermostat, and can be installed in frame garages in one hour by venting through an outside wall.
H. C. Little Burner Co.

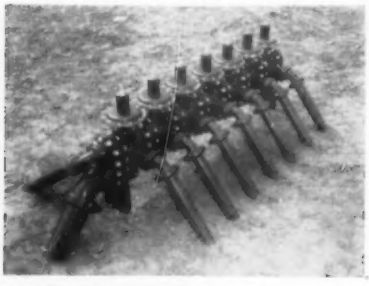


15. Digger-loader

A tractor-mounted combination excavating and earth-moving unit has been introduced by Sherman. It consists of a heavy-duty front-end loader and a lightning-detach power digger. Power is from a single hydraulic system that permits simultaneous operation of both pieces of equipment.
Sherman Products

16. Welders

Welding voltage is adjusted automatically on A. O. Smith's new diesel engine-driven welders. Only two indicators have to be set to operate the 300- and 400-amp direct-current units: one for electrode size, the other for desired current. Steady current curves are featured in the self-contained welders.
A. O. Smith Corp.

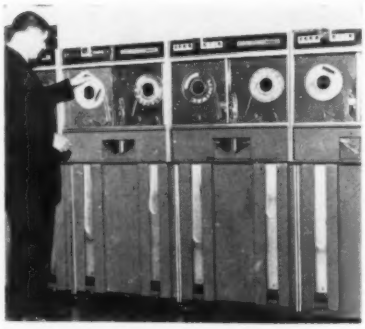


17. Three-way valve

National Tank's new three-way valve was designed primarily for use on lease well production manifolds. The Mani-Flo valve may also be used for mixing two different liquids or gases or as a switching valve to divert flow to different tanks or lines. In any application, it may be hydraulically, electrically, or diaphragm controlled and sensed by liquid levels, pressures, temperatures, times or differentials of these.
National Tank Co.

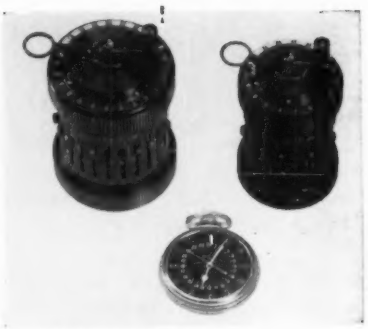
18. Flow meter manifold

The latest addition to Anderson, Greenwood's line of manifolds is Model M6C for flow meters. This assembly is equivalent to the conventional 5-valve manifold. It contains two mainline shutoff valves, a double block equalizer valve, and an atmospheric vent valve in a single, compact, barstock body. All of the valves use replaceable soft seats.
Anderson, Greenwood & Co.



19. Magnetic tape units

Magnetic tape units, used to process metallic or plastic tape, are now an integral part of Remington Rand's new Univac Solid-State computers. The new equipment will be available with a combined tape and punched-card input and output unit. One model uses 80-column punched cards, the other 90-column cards. Both use tape.
Remington Rand



20. Pocket calculator

The Curta is a complete pocket-size calculating machine for all four arithmetical operations. It adds, subtracts, multiplies, divides, squares, cubes, and extracts square roots. Curta can be held in one hand while operated and is easily carried in pocket or briefcase.
Feldmar Watch Co.

TRADE LITERATURE

21. Pipe tape

Warco laminated tape, an improved vinyl and butyl laminated pipe wrapping tape, is covered in a new bulletin from West American Rubber Co. The wrap is designed for top resistance to both abrasion and punctures from backfilling.
West American Rubber Co.

22. Service bodies

Dimensional and compartment data, optional equipment, design and engineering features of Holan's Series 5100 general service bodies are given in a new brochure. The general service bodies, built for ½- to 1½-ton truck chassis, are illustrated in detail.
Holan Corp.

23. Steel case meters

Bulletin 313 covers American tinned steelcase meters with capacities from 150 to 3200 cfh. Included in the new bulletin are data on design, construction and operation of the various meters. Dimensions, connections, and shipping weights also are covered.
American Meter Co.

24. Electric blasting

Atlas has published a manual on electric blasting. The compact handbook describes techniques to minimize cut-offs, help control throw, reduce noise, and improve breakage.
Atlas Powder Co.

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25. Flame arrestor

The National flame arrestor answers the need for safe operation of all fired equipment, wherever installed, under extreme or normal operation. A new illustrated bulletin from the company explains the need for flame arrestors and describes the National unit.
National Tank Co.

26. High capacity meter

American's new AL-800 Aluminumcase meter is covered in bulletin 314. The compact, lightweight meter has ample capacity for medium sized commercial or industrial loads. Its rated capacity is 800 cfh at ½-in. differential and 1700 cfh at 2-in. differential with 0.64 sp gr gas.
American Meter Co.

27. Eliminating explosions

Clark Bros. has presented the latest findings on the mechanism of explosions in pipelines and compressor starting air lines. The bulletin discusses research on the nature of explosions and shock waves in piping. These observations are then applied to compressor air starting systems.
Clark Bros. Co.

28. Printing calculator

Remington Rand's latest printing calculator, Model 99, is covered in a new illustrated bulletin. The bulletin gives a brief history of printing calculators.
Remington Rand

29. Unit-type compressor

Le Roi's Bulletin SG-2 covers Westinghouse unit-type compressors. The 12-page catalog has photos and cutaways describing G single-stage, YS single-stage, and YC two-stage compressors. Size range is from ½ to 15 hp. Pressures are available from 80 to 250 psi.
Le Roi Division

30. Pipe catalog

"Introducing Griffin Pipe" describes the new Griffin-20 cast iron pressure pipe. Also covered are Griffin's manufacturing facilities.
Griffin Pipe Division.

31. Product catalog

Modern Utility Supply has issued a comprehensive catalog of its plastic products. Descriptive information is included on plastic vents, combustible gas indicators, orifice meter gauge houses, instrument gauge houses, plastic service tee covers, pipe tape, leak detectors, residential meter housings, tube fittings, pipe alignment clamps, and serviceman tool trays.
Modern Utility Supply Co.

32. Electric plants

Onan's recently added line of high capacity electric generating plants is covered in the 1960 general catalog. The 2-color, 8-page bulletin lists more than 45 basic models of Onan gasoline and diesel engine-driven generator sets.
D. W. Onan & Sons Inc.

33. Pneumatic control

Two bulletins (501 and 501-S) describe a new electro-pneumatic control unit. This control gives accurate—on the second — cranking cycles as well as protection for engines. A steel, dustproof cabinet with "knock outs" houses the 1456 unit.
Synchro-Start Products Inc.

34. Telemetering

A new telemetering, monitoring and remote control system for gas distribution lines is described. Femco TMC is a wired system which telemeters levels, flow and pressures, and monitors and remote controls valves, pressure regulators and compressors between operations center and other points in the system.
Femco Inc.

35. Two-way radio

A new electronic device allows the operator of private two-way radio equipment to talk from a mobile unit into any public telephone service, local or long distance. Carterfone is described and illustrated in a catalog from Carter Electronics.
Carter Electronics Corp.

36. Trencher

A six-page illustrated bulletin describes Speicher's tandem drive trencher—a 1- to 30-ft per minute digging tool. Completely mobile, the rubber-wheel mounted unit features point-of-balance shifter, which allows a 24-in. shift forward or back.
Speicher Brothers

37. Fail-safe

The Panalarm fail-safe annunciator which differentiates between its own component failure and an alarm in the system being protected is the subject of Bulletin 108. The 4-page bulletin describes and illustrates the annunciator which uses two lamps per annunciator point—one to signal field abnormality and one to signal annunciator component failure.
Panellit Inc.

38. Centrifugal compressors

New engineering literature describes three styles of single-stage scroll casing compressors. Covered are Allis-Chalmers B style close coupled; the C style pedestal-mounted, ball bearing; and the D style bracket-mounted, pivoted-shoe bearing, single-stage centrifugal compressors.
Allis-Chalmers Mfg. Co.

39. Compaction

Compaction equipment produced by Wacker Corp. is described in literature available from the company. Two products are covered: The Vibro-Rammer, for all kinds of backfill including clay; and the Vibro-Plate for finishing of sandy or granular material, hot or cold asphalt, and for densifying dry mix, concrete with coarse aggregates, and soil cement.
Wacker Corp.

40. Pressure reducing valves

Atlas Type B pressure reducing valves are covered in a new 4-page folder. Features, installation information, photos and drawings of the valve, capacity charts and typical installation photos are featured.
Atlas Valve Co.

41. Transducer

The Hi-Ac Trans Model 106 transducer is designed to connect control computers to pneumatic equipment. A new bulletin explains the principle of operation and outlines the transducer's pneumatic and electrical rating specs, performance data, and special features of design for preliminary computing and control system studies.
Associated Control Equipment

42. Welding

Forty pages of a new manual feature a full line of gas welding, cutting, and allied equipment. Arranged in six sections in an 8½ x 11-in. format, the catalog has a six-page 11 x 33½-in. insert showing major products in cutaway drawings.
Smith Welding Equipment

THE *FINEST* FOR MODERN GAS DISTRIBUTION SERVICE

NORMAC

Insulating Couplings AND Fittings

Malleable Couplings

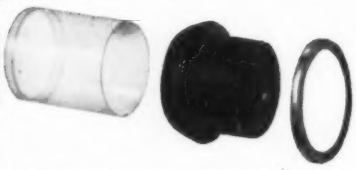
Normac Insulating Malleable Couplings and fittings are available with polyethylene inserts and semi-insulating gaskets or full insulating rubber gaskets.

Malleable Service Ell

The insulating principle depicted above is carried out in all Normac Ells and Tees.

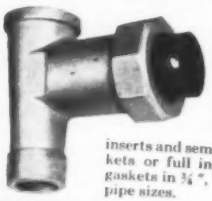
NORTON McMURRAY has specialized for 20 years in the development and production of products solely for the Gas Industry. Whether your plans include modernization, or new, expanded facilities, Normac Gas Distribution Equipment will serve you well.

Insulating Gaskets



The Normac insulating principle incorporates an efficient combination of a polyethylene sleeve and a semi-insulating gasket or full rubber gasket and retainer ring.

Brass Fittings



Normac insulating Brass compression end Tees, Ells and all compression end fittings are available with polyethylene inserts and semi-insulating gaskets or full insulating rubber gaskets in ¾", 1" and 1¼" iron pipe sizes.

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corrosion • *Continued*

from page 19

conditions and combinations can readily be answered by experiment. Conditions can be set up in a sand box (wetted with salt water to improve conductivity) and potentials measured at various positions. The use of a sand box serves two very useful functions, as compared with experimenting in the earth itself: First, we can obtain a uniform soil, thereby eliminating some of the vagaries caused by non-uniformity. Secondly, and more important, we can obtain complete freedom from unknown extraneous potentials and currents; we can put in the box exactly what we want, and know that it contains nothing else. ■

regulatory • *Cont'd.*

from page 12

"Staff excepts to the examiner's finding that Transwestern has shown an adequate supply of gas to support its project. The record shows that as of Jan. 1, 1958, Transwestern had proved natural gas reserves of 2,754,329 Mcf under contract and dedicated to it. Considering only these reserves, committed to it under the contracts which are part of these proceedings, the record shows a minimum deliverability of 308 MMcfd for 13 years. Staff contends that 13 years deliverability life is less than has been heretofore required by the Commission for major new pipeline systems such as this. No other party to these proceedings, however, has objected to the adequacy of these reserves.

"We agree with the examiner that 'it is reasonable to conclude from evidence in this record, that Transwestern's reserves will be steadily increased.' . . . Considering the extent of the natural gas reserves committed to Transwestern, together with the showing of additional new producing wells on acreage dedicated to it, and recognizing that this dedicated acreage is in some of the most active developing gas producing areas in the country today, the examiner was justified in finding that Transwestern's gas

supply is adequate to render the service proposed."

The new Transwestern pipeline to California will not meet the insatiable demands for natural gas for long. El Paso Natural Gas Co. has an application pending before FPC for authorization to deliver, in cooperation with Colorado Interstate, an additional 475 MMcfd to southern California. Another project would import 400 MMcfd from Canada to northern California. ■

Washington • *Cont'd.*

from page 17

pattern of producer regulation. The commission keeps trying, but there is increasing despair in its pleas for help to Congress, to the industry, to the courts, and to about anyone who will listen.

In addition, the past opposition of many gas distributors is coming under serious reappraisal. Whether as a result of the present control confusion or not, the fact remains that new discovery operations are not at past rates and that the volume of intrastate sales is increasing.

The futility of the present situation is pointed up in a recent speech by FPC Commissioner Frederick Stueck before the Independent Natural Gas Association of America.

As a means of developing a "set of standard acceptable practices and rules" for controlling the industry under the present system, he proposes an expanded "conference" consisting of the Natural Gas Industry Conference augmented by representatives of transportation and other utilities and cities. This conference would work with the FPC staff to write rules and regulations.

The outcome, he says, would be standard forms of contracts, smoothing out the peaks and valleys of annual gas consumption, and generally set standards for turning current prices in each area into methods of setting ceiling prices for old gas and top limits for prices for new gas.

Such an approach, however, would probably give the politicians a field day. Anti-gas industry and anti-FPC forces would pounce on

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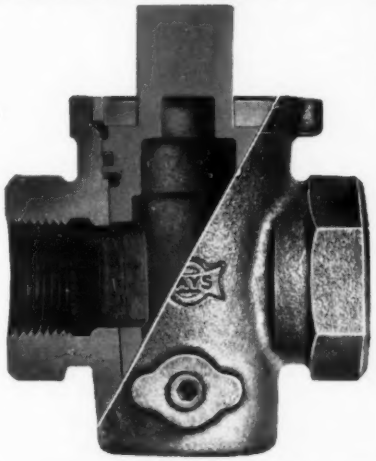

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- Stop is completely lubricated at the factory . . .
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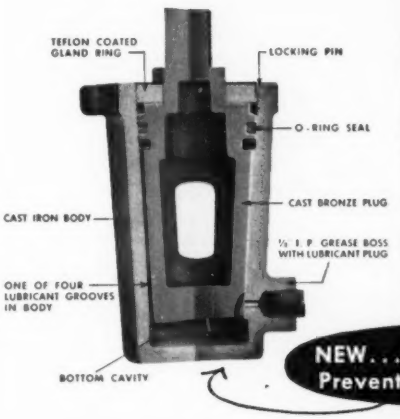

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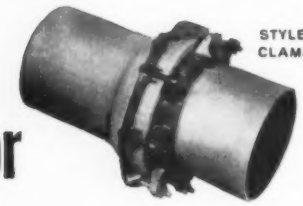

STYLE 60
CLAMP

or

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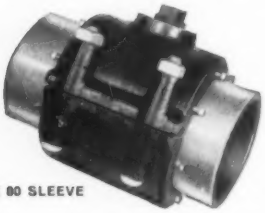

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the conference with both feet. Even though the conference could be set up without legal or even moral barriers, the opposition would have a firm base to criticize the industry for "regulating itself" and go on undoubtedly to charge that the consumer was again being "gouged."

THE U. S. Supreme Court is into a new term with a more conservative leaning than any time in recent years. As usual, there are hosts of cases affecting the gas industry now pending or due to come before it.

The high court has agreed to look into a case involving the right of judges to overrule the Federal Power Commission in interpreting contracts. The FPC is urging the high court to firmly establish that the interpretation of contracts is the power of the commission, and the courts may rule only on whether the rates have been set after proper evidence has been collected.

In other words, the FPC wants the courts to rule only on the methods, not on the facts of the case. Otherwise, the FPC contends, anyone unhappy with a rate can seek a new interpretation by the courts and endless litigation will result.

The commission also argues that permitting courts to set rates will undermine the congressional demand for uniformity in gas rates.

The case involves a contract between Texas Gas Transmission Corp. and Shell Oil Co., an independent producer. The FPC was overruled by lower courts in the case, which was its first interpretation of a rate contract filed by an independent producer after the high court decision in the Phillips case put independent producers under federal control.

A favored nations clause in the Shell-Texas Gas contract was ruled by the FPC to apply only to new contracts, not to price redeterminations. Shell was seeking higher rates from Texas, and in court won a reversal.

In another case, the high court has denied an appeal from its earlier decision in the so-called CATCO case. Long Island Lighting Co. had asked the court to amend its earlier decision to require a circuit court to maintain jurisdiction in the case while the FPC under the high court ruling considers what conditions to attach to the CATCO group's certificates.

And the court has heard arguments in the dispute over ownership of the gas and oil rich lands of the Gulf of Mexico. The federal government and the Gulf states of Texas, Mississippi, Alabama, and Florida are arguing over who owns mineral rights in the Gulf. The question is principally whether state boundaries extend outward in the Gulf by three miles or three leagues.

There are other gas industry cases before the court, and many will be added before it adjourns next spring.

Seasoned observers of the high court are convinced that it will continue in the trend of caution that started a couple of years ago. Some old-time lawyers sum it up by declaring the court now will shy away from deciding any more than it has to in each case and defer to Congress whenever possible. This, of course, is in sharp contrast to only a few years ago when the Court ranged far and wide, often creating its own issues and ruling on them. Reasons for the shift are probably many. For one thing, the deep and bitter criticism of the earlier court drift, going as high privately as President Eisenhower according to some reports, undoubtedly has had an effect. Recently-appointed members also appear to be more conservative.

While Earl Warren is still Chief Justice, his solid "liberal" bloc now is reduced to three including Justices Black and Douglas. They often get support from Justice Brennan, but the five remaining members while less well knit make up a definite conservative element. These include Justice Frankfurter, Clark, Harlan, Whittaker, and Stewart.

The conservatism of the court this year will probably show up mostly in cases dealing with states rights, particularly in labor and security issues, and in business and economic cases.

This could be an important factor in the outcome of the gas industry's pleas before the high court this year. ■

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NEW "stab-clad" couplings

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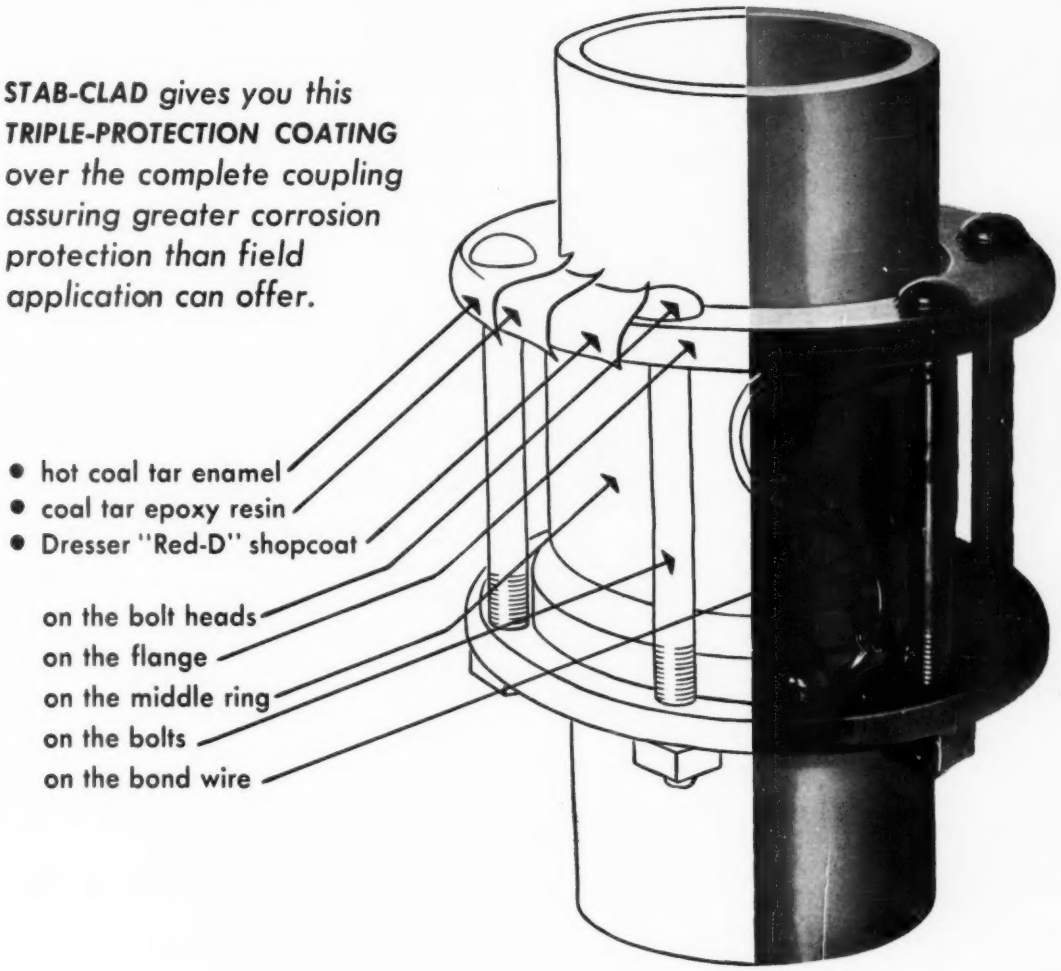
Revolutionize the installation of coated pipe!

***STAB-CLAD** gives you this **TRIPLE-PROTECTION COATING** over the complete coupling assuring greater corrosion protection than field application can offer.*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• coal tar epoxy resin
• Dresser "Red-D" shopcoat
on the bolt heads
on the flange
on the middle ring
on the bolts
on the bond wire

COATED PIPES can be strung more quickly and safely than ever before with these new Dresser® STAB-CLAD Couplings.

Save the time of on-the-job coupling assembly – for STAB-CLAD is a one-piece unit! When you stab in the pipe ends and tighten the bolts you *immediately* have a finished, permanent connection that is already coated and protected.

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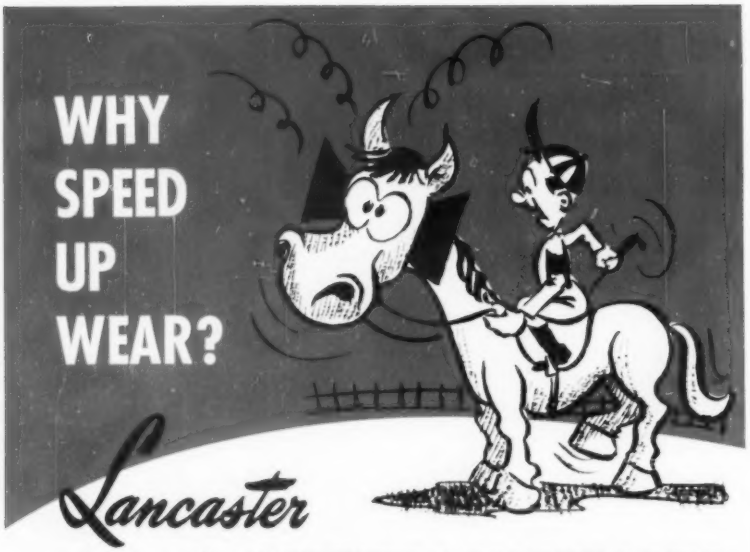

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GAS CALENDAR

December

3-4 . . SGA Transmission Section Roundtable — Sheraton-Dallas Hotel, Dallas.

3 . . NEGA Mfr. Dist. Div. Sales Managers Conference—The Maridor, Framingham, Mass.

1960

January

20 . . NEGA Operating Division — Sheraton Plaza, Boston.

February

29-Mar. 2 . . AGA General Management Section Conference—Pittsburgh-Hilton Hotel, Pittsburgh.

March

14-18 . . National Association of Corrosion Engineers Annual Convention, Dallas.

21-23 . . Mid-West Gas Association Annual Meeting & Convention—Hotel St. Paul, St. Paul, Minn.

24-25 . . NEGA Annual Meeting—Hotel Statler, Boston.

24-25 . . Oklahoma Utilities Association Annual Convention — Biltmore Hotel, Oklahoma City.

30-April 1 . . GAMA Annual Meeting—The Greenbrier, White Sulphur Springs, W. Va.

April

5-7 . . AGA Sales Conference on Industrial & Commercial Gas—The Shamrock-Hilton, Houston.

8-9 . . Florida-Georgia Gas Association Convention—Biltmore Hotel, Palm Beach, Fla.

19-21 . . Southwestern Gas Measurement Short Course—University of Oklahoma, North Campus, Norman.

19-21 . . AGA Research & Utilization Conference—Hotel Carter, Cleveland, Ohio.

21-22 . . Indiana Gas Association—French Lick-Sheraton Hotel, French Lick, Ind.

25-27 . . AGA-EEI National Conference of Electric & Utility Accountants —Roosevelt & Commodore Hotels, New York.

25-27 . . Southern Gas Association Annual Convention—Galveston, Texas.

May

9-13 . . AGA Commercial Gas School—Edgewater Beach Hotel, Chicago.

9-13 . . AGA Operating Section, Joint Distribution & Transmission Conference — Hotels Roosevelt & Jung, New Orleans.

from page 85

Cascade acquiring Oregon operation

Cascade Natural Gas Corp., Seattle, plans to acquire Eastern Oregon Natural Gas Co. by merger. Eastern Oregon headquarters in Ontario.

The boards of both companies approve the merger, but it is subject to approval by stockholders, the public service commissions of Washington and Oregon, and the holders of certain senior securities.

Under the terms, Ernest W. Jorgensen, president of Eastern Oregon, will become a director of Cascade and vice president in charge of Cascade's Oregon operations. No other personnel changes are anticipated.

With Cascade as the surviving company, stockholders of Eastern Oregon will exchange their stock for that of Cascade on a share-for-share basis.

The towns of Ontario, Nyssa, Milton - Freewater, and Hermiston are served by the Oregon company. Cascade operates gas distribution systems in 21 Washington and Oregon communities.

When the merger is completed, Cascade will be serving about 14,000 customers.

Richfield denied rehearing

Petitions for rehearsing on its cease and desist order to Richfield Oil Corp. have been denied by California's PUC (see November GAS).

Both Richfield and Southern California Edison Co. wanted rehearings on the commission's Oct. 9 ruling which ordered Richfield to cease selling natural gas to Edison at its Mandalay steam-electric generating plant in Ventura county.

Unity purchase complete

The gas system which for the past 15 years has been operated by Unity Gas Co. has been transferred to Saskatchewan Power Corp.

Negotiations for the purchase of the gas facilities in the Unity area of Saskatchewan commenced in June. Assets purchased include the Unity gas field, gathering system, transmission line, and the distribution system serving the town itself.

Although the Unity field is nearing depletion, it is important because of its potential as a storage field.

RIDGID Thread Cutting Oils are available in convenient (4 ounce Nu-Clear only), 1 quart, 1 gallon, (2 gallon Nu-Clear only), 5 gallon, 30 gallon and 55 gallon containers.

Tests prove RIDGID®
Thread Cutting Oil gives you better threads faster . . . lengthens die life, too!

Recently a distributor in Atlanta, Georgia investigated a complaint of "bad pipe". Test threads were made in all sizes. Torn threads resulted. Then RIDGID Nu-Clear Thread Cutting Oil was substituted for the oil being used. Perfect threads were obtained every time.

Here, then, is dramatic proof that you need a special purpose thread cutting oil . . . an oil that *cools, speeds metal removal, produces a smooth finish*, and *prevents chips from welding to your dies.*

No oil—in its pure state—will perform all these functions. That's why RIDGID Thread Cutting Oils are an exclusive, exactly formulated combination of oils, blended for easier, faster threading . . . longer die life. What's more, these special-purpose RIDGID oils are completely antiseptic . . . no danger of irritation or infection.

Make sure of good threads every time. Order RIDGID Thread Cutting Oil from your Supply House today. Tops for *all* metal cutting . . . you'll want an extra supply for your lathe, drill press and other metal cutting equipment.

RIDGID®
The Ridge Tool Company, Elyria, Ohio, U.S.A.

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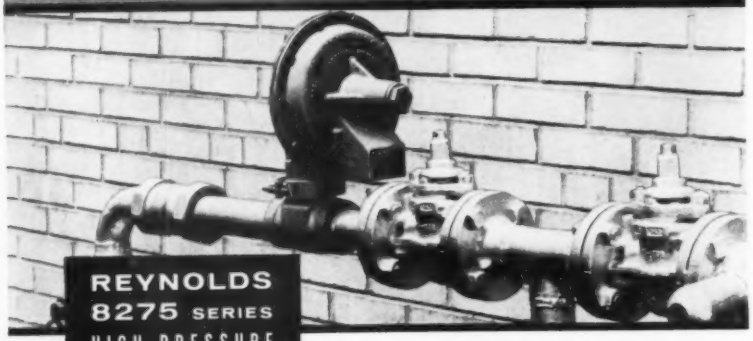
PERFECT HIGH PRESSURE HANDLER!



REYNOLDS 8275 SERIES HIGH PRESSURE SERVICE REGULATOR

IDEAL for SMALL COMMERCIAL AND INDUSTRIAL LOADS, SMALL DISTRIBUTION LOADS • FITS 1" & 2" PIPE

IF IT'S A REYNOLDS REGULATOR, IT'S RIGHT FOR THE JOB

GAS CONTROL SINCE 1892

THE ANSWER TO EXACT GAS REGULATION OF SMALL COMMERCIAL AND INDUSTRIAL LOADS:

SAFE: Full-opening internal relief valve prevents excessive buildup of pressure on customer's line.

VERSATILE: Variable head position. Interchangeable with Reynolds 8310 Series.

DURABLE: Corrosion and rust proof. Strong, stainless steel V-band coupling — No threaded connections to rust.

REYNOLDS GAS REGULATOR CO., INC.

ANDERSON, INDIANA *A Subsidiary of Arkansas Louisiana Gas Company*

Mined UNDERGROUND STORAGE FOR LPG

ENGINEERS . . . . CONTRACTORS

FENIX & SCISSON, INC.

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Petroleum council adopts emergency report

The National Petroleum Council unanimously adopted the report made by its Committee on National Emergency Oil & Gas Mobilization.

The study was prepared when the Department of Interior asked that the council (1) review and comment upon the "Proposed Plan of Interior's Office of Oil and Gas for Handling Petroleum and Gas During a National Emergency"; and (2) submit a list of nominees capable of staffing key posts in an emergency as full-time government employees in the emergency.

It was the consensus that the government's "Proposed Plan" was, in general, well considered and workable. However, it contains certain fundamental defects which, if not altered, will defeat the desired result of maximum supplies of oil and gas in a national emergency.

Nine key recommendations were made. Foremost was based on World War II experience and the importance of gas and oil in an emergency. It was suggested that the Plan should provide that all gas and oil operations under the Plan be handled by the Interior but so set up that the Secretary, at cabinet level, would be administrator of the Plan with authority to report directly to the President. The mechanical operations would be in charge of a deputy administrator of wide oil and gas experience, reporting directly to the administrator.

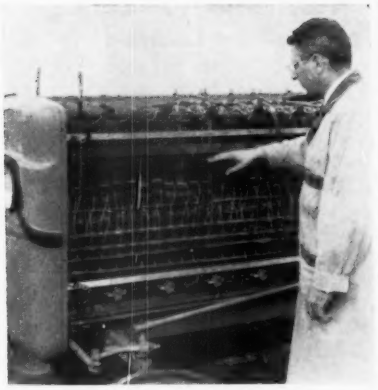
Other recommendations called for representation of the emergency petroleum and gas organizations at the OCDM level, legal considerations, jurisdictional boundaries of authority, and the problems raised by the geographical differences between OCDM regions and the PAD districts common to the oil and gas industries.

Complete copies of the report may be obtained from the National Petroleum Council, Suite 601, 1625 K St. N.W., Washington 6.

General forms Swiss firm

Latest in a series of European expansion moves by General Controls Co. is formation of General Controls Societe Anonyme (S.A.) in Switzerland.

The new subsidiary, in Fribourg, will handle all international operations, except North American activities, for the company.



Electricity produced by 1008 fuel cells powers this experimental tractor. T. G. Kirkland, member of A-C research team that built cells and installed them in engineless tractor, points to a unit of nine fuel cells.

Fuel-cell tractor shown by A-C

A new source of electrical power—fuel cells in this case fueled by a mixture of gases—has been used to power a vehicle.

Allis-Chalmers' fuel cell-powered tractor develops at least 3000 lb of drawbar pull, enough to pull a multiple-bottom plow.

Although the experimental model is of commercial size, Dr. H. K. Khrig, director of research and a vice president of Allis-Chalmers, said "it still is a research vehicle."

The electricity driving the tractor comes from 1008 individual fuel cells. These are joined in 112 units of nine cells each. The 112 units are arranged in four banks and electricity can be taken from any combination of the banks.

The gas used here was largely propane. The gases are fed into the cells through a system of tubing. Once in the cells, they react in an electrolyte. A catalyst coating the electrodes of each cell aids the reaction.

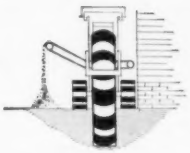
Chemical reactions within the cells cause a direct current to flow through an external circuit which is connected by bus bar to a standard controller.

The controller permits the driver to regulate speed or reverse the tractor's direction by moving two levers. Using the speed control, the operator places the four banks of cells in series or parallel, varying the amount of current going to the motor.

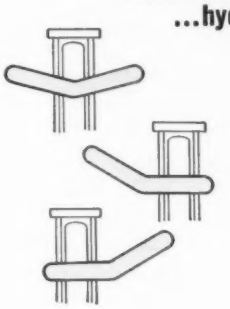
THE MACHINE for lower-cost digging

the CLEVELAND J-20 trencher

- less than 5' wide over its crawlers
- digs 13" to 24" wide, down to 5' 6" deep
- puts 24" trench within 20 inches of a parallel wall
- maneuverable full crawler mounting . . . perfect balance and stability, easy on lawns and sidewalks
- fast, accurate, clean, dependable . . . nothing digs trench like a Cleveland

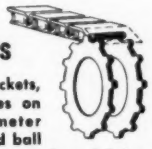


Cleveland's unique new V conveyor . . . hydraulically shifted . . . independently driven



- digs past poles, trees, shrubs . . . places spoil where needed — without interrupting other operations
- lever at operator's seat controls hydraulic shifting and positioning of conveyor
- dual independent hydraulic drive gives operator fingertip control of conveyor belt direction and speed — independent of all other operations
- self-contained hydraulic motor and planetary gear drives in each head pulley eliminate all conveyor chains and sprockets
- provides constant elevating angle for faster, higher spoil discharge
- Maximum clearance under digging wheel rims permits higher heaped loads without clogging
- conveyor design reduces rolling and tumbling

world's finest trencher crawlers



. . . double flanged sprockets, rollers, wheels . . . drives on each end of 1½" diameter hardened pins . . . sealed ball and roller bearings . . . 1,000 hour lubrication . . . a tremendously long-lived, easy-rolling track.

hydraulic crumbing shoe

. . . optional, extra . . . pivots upward . . . fingertip control makes crumbing shoe advantages practical in crowded digging conditions.

EVERY OPERATION controlled at operator's seat

The CLEVELAND TRENCHER Co.

20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

Give Your Home a Gaslite for Christmas

Gaslites BY ARKLA

Brighten your holiday season and the whole year through with distinctive Gaslites by Arkla for your home. A superb line of traditional and contemporary gas lighting fixtures, Gaslites by Arkla are designed to lend graciousness to any outdoor setting . . . a mark of the owner's taste for beauty.

For full specifications and prices, please write Arkla • Gaslite Division Shannon Building, Little Rock, Arkansas

Here's The "Jeep" You Asked For!

AN ENTIRELY NEW LOW COST ALL-PURPOSE DETECTOR

Tinker & Rasor

MODEL E-4 DETECTOR

- Lightweight
- D. C. Output
- Shock Proof Case
- Adjustable Voltage
- Non-Destructible Type Material

The Model E-4 Detector is a portable instrument designed for all-purpose work and is adaptable to both large and small pipe. It features direct current, high potential output, accurate bell signal alarm, and is adaptable to both the full circle and half circle electrodes. It is adjustable from 5000 to 20,000 volts D. C. and offers a shock proof, non-destructible type case.

Write today for prices and complete detailed information.

TINKER & RASOR

417 Agostino Rd., P.O. Box 281, San Gabriel, California

Documentary TV series planned by Laclede

A special TV series about St. Louis is planned by Laclede Gas Co. The filmed documentaries, slated for January viewing, will trace the city's role in aviation history, the Mississippi River and the Gateway to the West, and the 1904 World's Fair, along with other highlights of the city's history.

Laclede was a pioneer user of radio. It also was one of the first to enter television with regular programming in St. Louis 12 years ago. And it was the first commercial user of stereophonic broadcasting and telecasting in the city.

The new series is another first for Laclede—the use of mobile video-tape unit operating throughout the area to reproduce the material needed for a documentary of this type. The tapes will be combined with historic film clips and live action.

NFPA revises fire codes

Important changes in fire safety standards are contained in a new and revised edition of the National Fire Codes.

The six-volume, 1959, edition is a compilation of 177 standards developed by the National Fire Protection Association. Fields covered: flammable liquids and gases; combustible solids, dusts, chemicals, and explosives; building construction and equipment; extinguishing equipment; electrical installations; and transportation.

New material includes 60 new or revised fire safety standards adopted at the 1959 NFPA annual meeting. It also incorporates all amendments approved up to and including July 30, 1959.

Additional information on the codes is available from the NFPA, 60 Batterymarch St., Boston 10. They sell for $7 per volume or $35 for the set of six.

Rochester buys company

Rochester (N. Y.) Gas & Electric Corp. has PSC approval to buy the Churchville (N. Y.) Oil & Natural Gas Co.

Churchville is owned by Pavilion (N. Y.) Natural Gas Co.

Sale includes part of a natural gas transmission line owned by Pavilion.

BU studies liquid gas

Brooklyn (N. Y.) Union Gas Co. is studying the possibilities of large scale liquefaction of natural gas to meet peak demand periods.

The $18-$20 million project could be undertaken alone or with other companies as a joint effort. Preliminary forecasts call for 50 MMcfd to supplement present gas supplies.

Value Line theory told

"The Evaluation of Common Stock" tells of the evolution, over the past 21 years, of the unique and objective Value Line methods of stock evaluation.

Author of the book is Arnold Bernhard, founder and editor of The Value Line Investment Survey. He tells how to project the normal value of stocks into the future.

Additional information on the book is available from The Value Line, 5 East 44th St., New York 17.

Washington expands

Washington (D.C.) Gas Light Co. wants to buy Shenandoah Gas Co., Winchester, Va. Washington plans to operate the $2 million company as a subsidiary.

Petitions are on file with regulatory bodies for permission to acquire 69 per cent of the outstanding stock of Shenandoah for $514,-513. If possible, Washington would like to acquire all of the company's stock.

The four-year-old Virginia company has been losing money. It serves mostly industrial customers in Winchester and Martinsburg. Washington Gas feels that its predominantly residential operation will mesh profitably with Shenandoah's industrial business.

Magnaflux Corp. sold

General Mills Inc., has acquired the Magnaflux Corp. of Chicago. Magnaflux, specialist in techniques and equipment for detecting flaws, will operate as a wholly owned subsidiary of General Mills.

R. A. Wilson, GM vice president and general manager of its Mechanical division, is the new president of Magnaflux. W. C. Babcock, of General Mills legal department, is secretary. F. B. Doane, one of the founders and president of Magnaflux, is retiring from active management after 30 years with the company.

CUT 20" CAST IRON PIPE
in Less Than 8 Minutes...

...with the New REED
ROTARY CUTTERS
(4 sizes cover the range from 10" cast iron to 26" steel pipe)

These one-man Reed Rotary Cutters cut large diameter steel or cast iron pipe *faster and better than the heaviest power machines* . . . and without electrical or explosive hazards. What's more, there's less digging in ditch-work! You need only a 4" to 6" channel under the pipe and a 45° to 60° arc for the handle swing. Reed Rotaries are easy to "carry in", too. The 20" size weighs only 68 pounds; separates into 3 easily carried parts. Patented pipe guide assures clean, right-angle cuts. Four razor blade wheels track perfectly, cut easily and are quickly interchangeable for steel or cast iron pipe.

- Write today for descriptive literature.

These typical cuts on 12, 16, 20 and 24" cast iron pipe illustrate the clean, accurate, right-angle cuts provided by Reed Rotary Cutters.

REED
REED MANUFACTURING COMPANY
ERIE • PENNSYLVANIA

STOP H_2S CORROSION BEFORE IT STARTS!

The Connelly IRON SPONGE purification process at the well site removes hydrogen sulphide BEFORE the gas is piped to central processing. Thus, the cause of pipe line corrosion is eliminated because corrosive gas never enters the transmission lines. Additionally, Connelly IRON SPONGE eliminates the need for extreme close control. It operates with high efficiency at low or high pressures—absorbs more H_2S, gives longer service between foulings and is easily regenerated. If you have a purification problem check this MOST ECONOMICAL solution today. Write for Field Processing Bulletin #OG-7.

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GAS·PEOPLE

Fenton Finn
N. Y. Natural

Richard Plank
N. Y. Natural

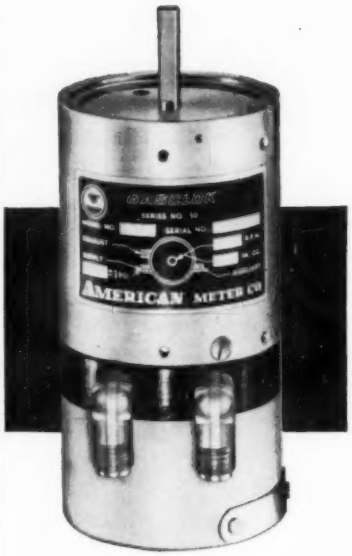
RICHARD J. PLANK has been named executive vice president of New York State Natural Gas Corp., Pittsburgh. On Feb. 1, 1960, Plank will become president of the company, succeeding FENTON H. FINN, who plans to retire. Plank has been vice president for operations of the Peoples Natural Gas Co., a Consolidated Natural Gas System affiliate. He also has served as chief engineer for both Peoples and New York Natural. Finn is retiring from corporate management to devote his time to geology and engineering. He plans to work as a consultant on problems of gas production and gas storage. Initially he will work on such problems in the Consolidated system. Finn joined New York Natural and Peoples in 1932 as geologist, advancing to chief geologist and production engineer in 1939. He became vice president of New York Natural in 1951, president in 1953.

MARTIN J. TUCKETT is general sales manager of Greenlee Tool Co., Rockford, Ill. He joined the company in 1957 as assistant to the vice president in charge of sales. DELBERT WILSON was named assistant sales manager.

M. H. THOMAS has joined Norman Products Co., Columbus, Ohio, as assistant to the president. RICHARD G. MILLIKAN, with Norman since 1950, has been appointed sales manager.

THOMAS J. MCSWEENEY has been named manager of Norge's newly formed data processing, systems and procedures department.

GEORGE AMES is field manager, pipeline sales, for Gar Wood Industries Inc., Wayne, Mich. Ames will headquarter in Findlay, Ohio.



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POWER DRIVE

Completely self-contained gas or air-powered instrument driving and timing unit for long, trouble-free operation in remote locations. The GASCLOK delivers more than 20 times the torque of conventional spring-wound mechanisms. Continuous timing accuracy is unaffected by a ± 20% variation in supply pressure.

Inherently explosion proof and self-starting, the GASCLOK is ideal as original or replacement equipment for strip chart and conventional circular chart instruments. The timing mechanism is internally sealed to prevent corrosion, and all power unit parts exposed to gas are aluminum or stainless steel. Large area internal ports prevent clogging. Normal air or gas consumption 5 cfh . . . operating pressure 5 psi . . . rotation 2 rpm.

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METER COMPANY
INCORPORATED (ESTABLISHED 1836)

Executive Offices: Philadelphia 16, Pa.
Sales offices in principal cities.

CHRISTY PAYNE JR. is heading an extensive program of market development for Consolidated Natural Gas Co. Payne has been vice president of Peoples Natural Gas Co. since 1947. As Consolidated System manager of market development, he will work with Peoples Gas, New York State Natural Gas Corp., East Ohio Gas Co., Lake Shore Pipe Line Co., Hope Natural Gas Co., and River Gas Co. He will headquarter in Pittsburgh.

C. CHURCH MORE has joined Adams Pipe Repair Products, South El Monte, Calif. In addition to general administrative work, More is directing an expanded advertising and sales promotion program for the company.

Christy Payne Jr.
Consolidated

C. Church More
Adams Pipe

Ralph Davidson
Grayson

James Perley
Consolidated

JAMES D. PERLEY has joined Consolidated Natural Gas Co. as director of employee relations. Perley formerly was assistant vice president of personnel for Westinghouse Air Brake Co.

RALPH J. DAVIDSON is Pacific Southwest district sales manager for Grayson Controls Division, Robertshaw-Fulton Controls Co. Davidson has been a Grayson sales representative since 1956.

L. L. BAXTER, president of Arkansas Western Gas Co., Fayetteville, has been appointed to the Arkansas Industrial Development Commission.

48′ BORE under highway for distribution line

with KA-MO 12″ dia. drill

To run a gas distribution line under main highway, a portable Ka-Mo horizontal drilling unit quickly bored a 12″ diameter hole, 48′ long, through hard compacted clay. Drill was powered by a 7½ h.p. air motor on standard double-track mounting. On similar type work, casing can be installed at the time hole is drilled, by using the casing attachment — giving maximum protection against costly cave-ins.

Ka-Mo offers tremendous versatility . . . light, portable drills . . . easy to operate for installing gas lines under streets, highways, railroads. Drills through sand, clay, gumbo, frost, shale, limerock, other mineral formations. Air, electric, hydraulic, diesel, gasoline engine powered.

100′ BORE and casing installation for gas main

This 20″ diameter Ka-Mo drill was used inside casing to bore a hole 100′ long through hard clay, under a railroad bed for new gas main. Drill was powered by a 15 h.p. air motor. Notice that drill and casing move forward at the same time.

Next time you have a drilling problem, check the Ka-Mo line. Drill sizes 2″ to 48″ dia. and larger, in sectionalized lengths are tailored to meet your own particular requirements. Information is available at no obligation. Fill out and mail coupon today.

Mail to: KWIK-MIX Co., Ka-Mo Tools Dept., Port Washington, Wisconsin

☐ Send us free 12-page KA-MO bulletin ☐ Have distributor call

NAME ..... TITLE .....

COMPANY .....

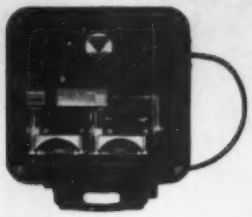
STREET .....

CITY ..... STATE .....

KAM906 GAS

KA MO — KWIK-MIX COMPANY — Ka-Mo Tools Dept.
A DIVISION OF KOEHRING COMPANY

FOR ACCURATE
FLOW MEASUREMENT
365
DAYS A YEAR



USE AMERICAN® BASE VOLUME AND BASE PRESSURE INDEXES

American BASE VOLUME INDEXES register gas quantity at standard conditions of base temperature and base pressure. BASE PRESSURE INDEXES automatically multiply volume at line conditions by the pressure factor and indicate quantity at base pressure on a straight reading index.

No computations...accurate gas volumes at base conditions are shown immediately. A second counter on the back indicates volume at line conditions. Simple operating principle... integration is continuous with all functions performed mechanically through special gearing.

Write for Bulletins 200 and 201.

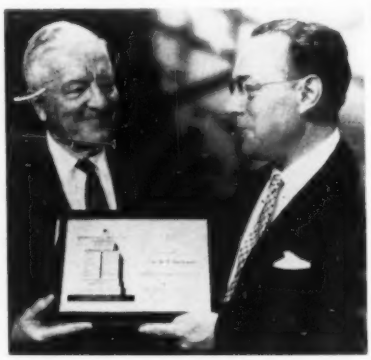
AMERICAN® METER COMPANY
(INCORPORATED ESTABLISHED 1836)
General Offices: Philadelphia 16, Pa.
Sales Offices in Principal Cities

Rockwell Manufacturing Co. has promoted three supervisors to newly created office management posts in Pittsburgh. EDWARD W. WRENCH is headquarters office manager for the meter and valve and municipal and utility sales divisions; CHARLES D. SCOTT, power tool division; and EUGENE A. LEWICKI, advertising and public relations department.

GEORGE E. HULSE is director of the newly formed research and development department of Chemetron Corp's Chemical Products division. He will headquarter at the Rock Hill Laboratory in Newport, Tenn.

JOHN G. SMITH has been transferred by Pacific Gas & Electric Co., San Francisco, to Calgary, Alberta, to assist in preparations for the Alberta - California gas pipeline. Smith has been East Bay division gas engineer for PG&E. In his new post, he will be executive assistant to Charles Pennypacker Smith, vice president and manager of Alberta & Southern Gas Co. Ltd., PG&E's gas-purchasing subsidiary.

ROBERT LAWRENCE has joined Caloric Appliance Corp., Jenkintown, Pa., as marketing manager. He will be responsible for all studies and advisory services related to marketing.



Col. Willard F. Rockwell (left), chairman of the board of Rockwell Manufacturing Co., receives a Freedoms Foundation Honor Certificate Award from Dr. Kenneth D. Wells, president of the Freedoms Foundation. The award was for "outstanding speeches and writings in the economic education field." Col. Rockwell received an earlier award in 1950 for "outstanding achievement in bringing about a better understanding of the American way of life."

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Heat and vibration-proof, non-solvent, will not shrink, crack or crumble. Makes all assemblies leak-proof and pressure-tight. Prevents rust, corrosion, joint seizure.

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LIQUID WRENCH®
The super-penetrating rust solvent

LOOSENS
rusted bolts, nuts, screws, 'frozen' parts

Liquid Wrench works *fast*... yet is absolutely safe for all metals and alloys.

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At Industrial, Automotive, Hardware, Plumbing Jobbers

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Charlotte, North Carolina

"W" Type Survey for downtown and commercial areas

includes street and building inspection. This Heath Leakage Control Survey accurately locates and classifies gas leakage. It reduces unaccounted for losses and gives the obvious advantage of a 3rd party Audit of your leakage situation.

• • •

Write for information about a Heath Survey of your properties.

The Safety Service That Saves Gas

HEATH
Survey Consultants, Inc.
378 Washington St., Wellesley Hills 81, Massachusetts

Richard DuVall
Peoples Natural

Robert Seymour
Peoples Natural

Several management appointments have been made by Peoples Natural Gas Co., Pittsburgh. RICHARD E. DUVALL, formerly superintendent, is now vice president, operations. Another new vice president is ROBERT E. SEYMOUR, administrative. Seymour previously was assistant to the president.

George Kline
Peoples Natural

Robert Swagler
Peoples Natural

Newly appointed general superintendent is GEORGE K. KLINE. Succeeding him as assistant to the general superintendent is ROBERT C. SWAGLER, former western division manager in Glenshaw.

JOHN W. NORTHCUTT, assistant vice president of Rockwell Manufacturing Co., Pittsburgh, has been named an advisor to the Director of the Water and Sewerage Industry and Utilities Division, Business and Defense Services Administration, U. S. Department of Commerce. Northcutt joins BSDA under an arrangement by which industry makes executive personnel available for temporary assignment without compensation from the government.

LURTING K. BEATTY has been appointed air conditioning sales manager for the Peoples Natural Gas Co., Pittsburgh. As a member of the general sales staff, Beatty will direct commercial, industrial and domestic air conditioning activities of the company.

Koenig ALL-STEEL UTILITY BODIES

LINE-CONSTRUCTION BODY
. . . available in 9' to 14'6" lengths with mechanical or hydraulic winch and derrick, or any other special or custom equipment desired. Compartments can be arranged to your specifications.

SERVICE BODIES
. . . for ½-, ¾-, and 1-ton chassis. Electrically welded into one unit with six waterproof compartments, recessed paddle handles keyed alike and fender skirt protected with die-formed rolled edges. Built for safe, dependable service . . . will outlast several chassis.

3-WAY DUMP BODIES
DUMP to the RIGHT, LEFT and REAR
All-steel welded bodies available in 8' to 11' lengths. The multistage telescopic hoist has a lifting capacity of 25,000 lbs. This is the ideal body for safe dumping under hazardous conditions . . . especially adaptable for windrowing and backfilling.

YOU CAN BE SURE OF QUALITY MATERIALS AND WORKMANSHIP WHEN YOU SPECIFY KOENIG PRODUCTS
Write for literature and specific information today.

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Deaths

BEN C. ADAMS, SR., chairman of the board of the Gas Service Co., Kansas City, Mo., died recently. He was 79 years old. Mr. Adams' utility career was launched in 1903. He began the job of organizing the Gas Service properties in 1925. From a group of run-down companies, he made the firm into one of the country's leading utilities. From 1925 until 1940, Mr. Adams served as vice president and general manager of Gas Service. In 1940 he was named president and retained that title until 1956 when he became chairman of the board.

F. TOM PARKS, 69, former vice president and board member of Public Service Co. of Colorado, died recently. He spent 42 years in the utility business—in refineries, oil and gas production, gas transmission, and gas distribution. Mr. Parks joined PS Co. of Colorado in 1928. Under his direction, natural gas was introduced into Denver, Pueblo, and other Colorado towns, and into Cheyenne, Wyo. He became a member of the board in 1939 and was elected vice president in 1943. He also held directorships in Colorado Interstate Gas Co., Colorado Oil & Gas Corp., and Natural Gas Producers Inc.

FRANK J. TRELEASE, 72, pioneer builder of natural gas pipelines, died recently in Oxford, Md. He retired in 1947 as a senior consulting engineer with Ford, Bacon & Davis Inc. after 33 years with the engineering firm. Mr. Trelease was an authority on the design and construction of long-distance, high-pressure natural gas lines. He was one of the pioneers in the field, having had charge of the construction of one of the earliest such lines. It ran from Monroe, La., to St. Louis, Mo., and is today part of the Mississippi River Fuel Co.'s system. For several years he was manager of the Colorado Interstate Gas System in Colorado Springs.

JOHN I. TRIMBLE, 54, vice president and general manager of the Janitrol Heating & Air Conditioning Division of Surface Combustion Corp., died recently in Columbus, Ohio.

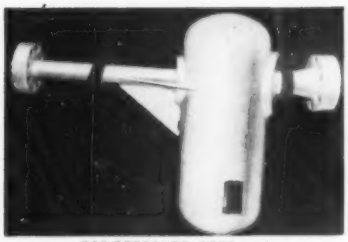
GAS

PIPELINE SECTION

A discussion that should be of interest to measurement engineers—both distribution and pipeline

THE PITOT TUBE

another measurement tool



GAS PRESSURE, 1500 p.s.i.

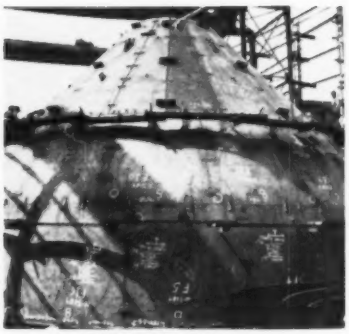
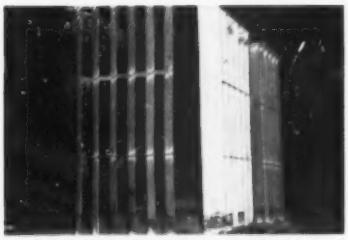
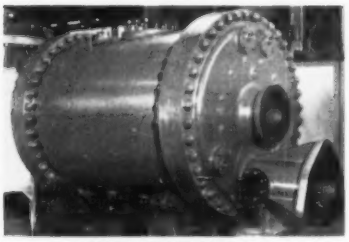


PLATE WORK, 55′ dia. cone

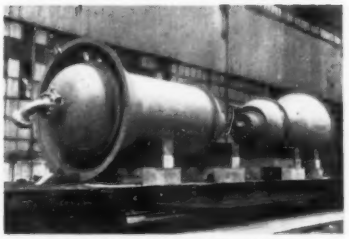
GALVANIZING POT



SPECIAL ALLOY STEEL DEFLECTORS

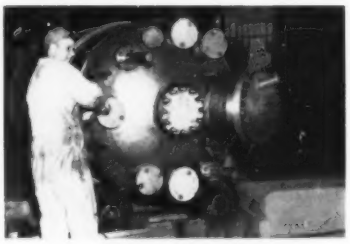


SPECIAL CHEMICAL VESSEL

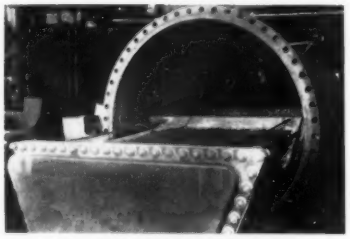


SPECIAL STAINLESS VESSELS

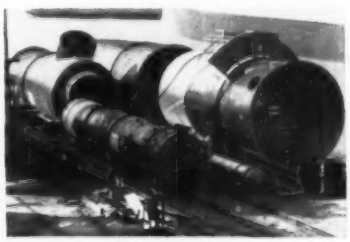
TOWER, 8′6″ dia. x 154′ in length



STAINLESS AUTOCLAVE



SPECIAL CONDENSER



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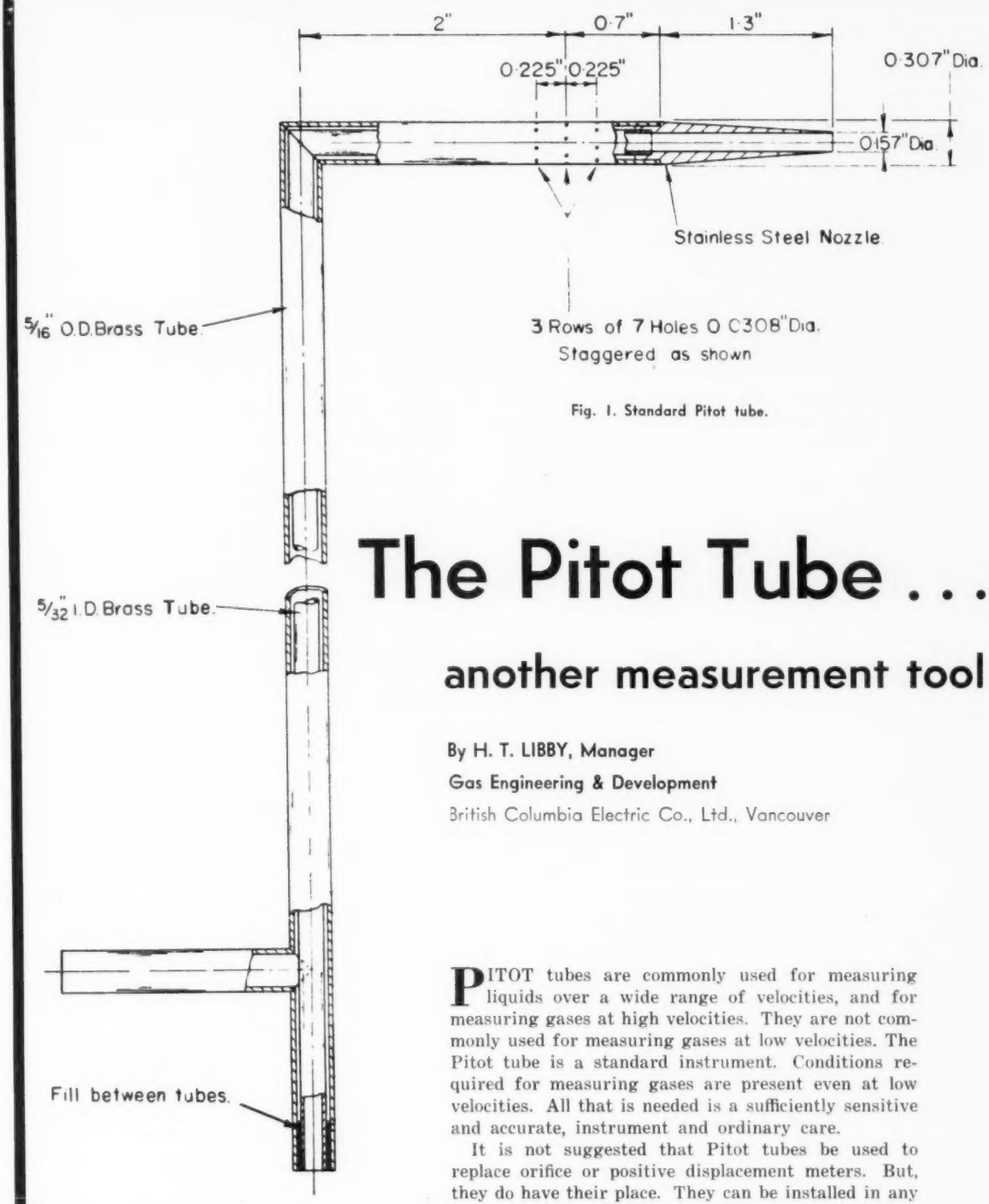


Fig. 1. Standard Pitot tube.

The Pitot Tube . . .

another measurement tool

By H. T. LIBBY, Manager
Gas Engineering & Development
British Columbia Electric Co., Ltd., Vancouver

GAS exclusive

PITOT tubes are commonly used for measuring liquids over a wide range of velocities, and for measuring gases at high velocities. They are not commonly used for measuring gases at low velocities. The Pitot tube is a standard instrument. Conditions required for measuring gases are present even at low velocities. All that is needed is a sufficiently sensitive and accurate, instrument and ordinary care.

It is not suggested that Pitot tubes be used to replace orifice or positive displacement meters. But, they do have their place. They can be installed in any line or duct, regardless of size, pressure or location, without disturbing the operation of the line, and without introducing additional pressure losses. They are invaluable for determining the direction and magnitude of volumes flowing in low and high pressure networks. Velocities as low as 2 or 3 ft. a second can be measured. Accuracies in the order of ± 2 per cent are within the reach of the careful operator.

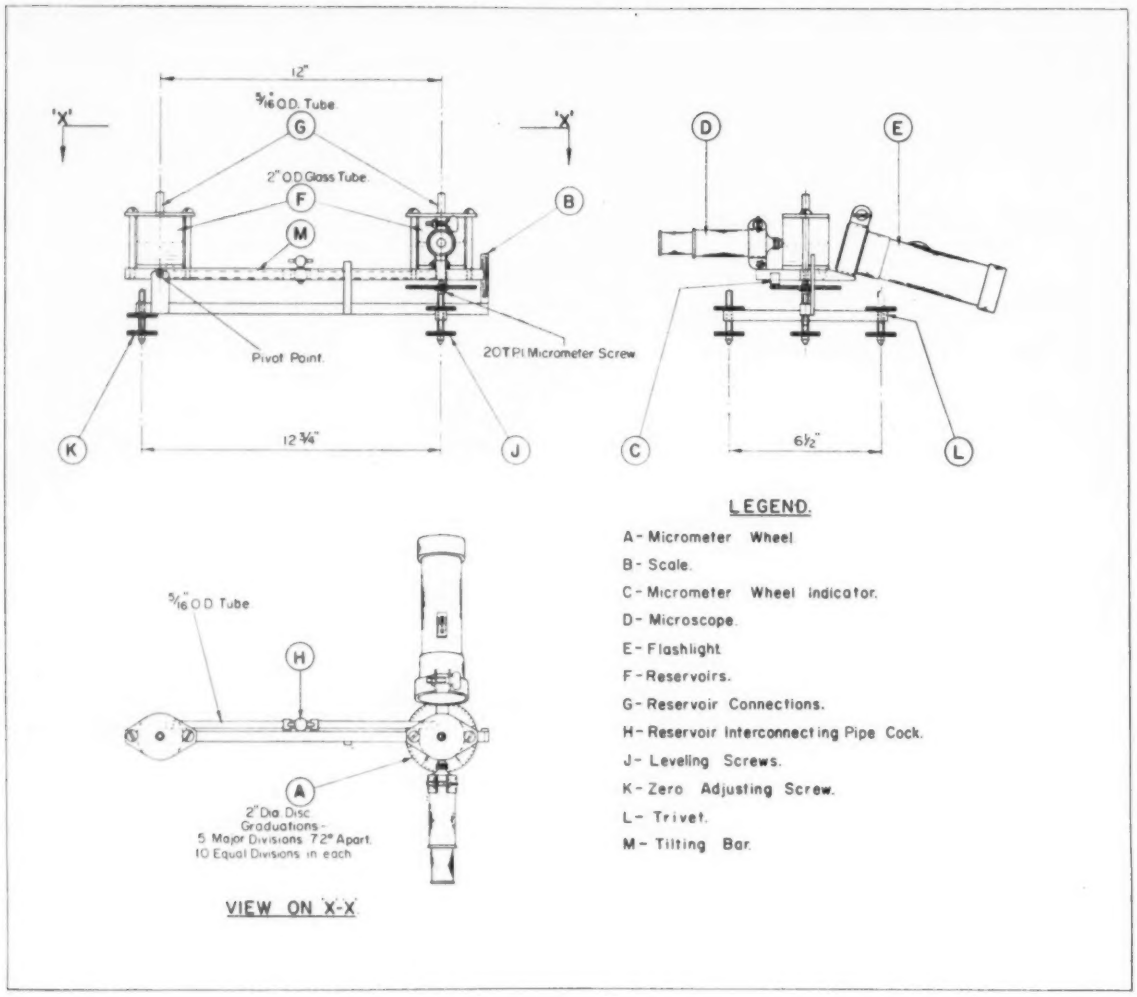


Fig. 2. Tilting micromanometer.

• Gas measurement by the Pitot tube

In 1730 Henri Pitot found that when he held an "L"-shaped glass tube in the River Seine in Paris, with the horizontal arm of the tube facing upstream, the water rose in the tube above the height of the surrounding water. He also observed that the rise above the surrounding water varied with the square of the velocity of the water impinging on the end of the tube.

To explain this phenomenon, let us assume that a small group of particles approaches the mouth of the tube with progressive decelleration, becoming zero at the end of the tube. Their kinetic energy has been converted into potential energy in the form of a small column or head in the tube. The small pressure head (h) developed by this impingement is known as the velocity head.

Bermoulli, in his equation that forms the foundation for hydraulic calculations, shows that

$$\frac{V^2}{2g} + \frac{P}{W} + Z = \text{a constant}$$

where V = velocity
g = gravitational constant
P = pressure
W = weight of the liquid per unit volume
Z = datum

Therefore, the total energy of a particle of water in the river can be described by that formula. Since the water at the surface has no pressure, and since the surface could be considered as datum, the formula would become

$$\frac{V^2}{2g} + 0 + 0 = \text{a constant}$$

The equation can also be used as the energy equation in the Pitot tube. In this case the velocity head $\frac{V^2}{2g}$ is zero, the river surface is datum and zero, and the total energy is in the $\frac{P}{W}$ element of the equation.

The equation now becomes $\frac{V^2}{2g} = \frac{P}{W}$ where P is the

pressure exerted by the head of water in the Pitot tube.

In a column of liquid if the pressure per unit area is divided by the weight per unit volume, the result is the height of the column. It can be called the head pressure or head, $\frac{P}{W} = h$. The equation now becomes

$$V^2 = 2gh \text{ or } V = \sqrt{2gh}$$

Pitot also noticed that if the horizontal arm were placed at right angles to the stream, the water in the tube stood slightly below the surrounding water level. This depression of the head was caused by the eddies at the end of the tube.

• The Pitot tube

Pitot's original experiment can be repeated to determine the velocity of liquids in open channels. But when the velocity of a fluid in an inclosed conduit is to be measured, the total head (h) will equal the velocity head $\left(\frac{V^2}{2g}\right)$ plus the static head $\left(\frac{P}{W}\right)$ on the pipe, i.e.,

$$h = \frac{V^2}{2g} + \frac{P}{W}$$

Before the velocity head can be determined separately, the static head on the pipe must be determined to a high degree of accuracy.

It was previously noted that a pipe at right angles to the flow did not register a correct static pressure. This also holds for openings drilled into the sides of pipes. Experimenters have found that the eddies set up around the mouth of the Pitot tube cause a slight drop in pressure which extends for some distance along the nozzle. They also found that a slight pressure is set up ahead of the vertical part of the tube. Further experiments found that a point could be located where these pressures cancel each other. A static pressure tube designed with a ring of holes at this point of neutral pressure has been proven to give true static pressure readings. In order to simplify the construction and use of the Pitot tube, the velocity head tube can be surrounded by the static pressure tube. This has the further advantage of taking the static pressures and velocity heads as closely together as possible, thus precluding the chance of error due to a difference in pressure between the two points. The Pitot tube shown in *Fig. 1* has been carefully tested and has been proven to have a coefficient of 1. Tubes with a coefficient of 1 are also obtainable from most scientific supply houses.

In constructing Pitot tubes, any plain tube facing directly into the stream will give a true velocity head indication but the placement of the static pressure openings will have a marked effect upon the coefficient of the tube. If the static pressure opening is placed facing downstream, for instance, it will give a reading somewhat below the true static pressure. And the depression below the true static pressure will vary with the square of the velocity. The overall effect will be for the tube to render readings that are a true function of the velocity but somewhat greater than those obtained by using the standard Pitot tube. In taking readings at low velocities, this is a decided advantage. In practice, it may be beneficial to take the readings with special tubes and use the standard Pitot tube only for determining by comparison the coefficients of the special tubes. For instance, a very small Pitot tube would be desirable for taking pressures in small pipes, so as not to affect the flow. A double-ended Pitot tube can be made that can be inserted in high pressure lines against the pressure through a gland and corporation cock without loss of gas. Once the coefficient for the tube has been determined, it can be used for correcting all readings taken with that tube.

• The manometer

If a Pitot tube were placed in a stream of water with a velocity of 5 ft. per second, by the formula $V^2 = 2gh$ we would expect a velocity head of 4.65 in. wc. If the tube were placed in an air stream of 5 ft. per second, we would similarly have a velocity head of 4.65 in. of air. Of course, a column of air exists only in theory. In order to read such a velocity head, we would have to connect the tube to a manometer and convert the reading to inches of column of some liquid. By connecting the velocity head tube to a manometer, a reading is obtained which is the sum of the static pressure and the velocity head. By connecting the static pressure tube to the opposite side of the manometer, the static pressure is cancelled out, and only the velocity head is left. If an ordinary water filled U gauge were used, since water weighs approximately 815 times as much as air, the reading would be only .0057 in. wc. Had the velocity been 6 ft. per second, the reading would have been .0082 in. wc. The accuracy, then, in measuring velocities in air between 5 and 6 ft. per second depends upon the accuracy with which pressures between .0057 in. and .0082 in. wc can be measured. The problem is exaggerated proportionately when gases lighter than air are to be measured. Obviously, something better than an ordinary U tube is required for measuring gases at very low velocities.

Current literature reveals a number of different types of manometers. In general, it will be found that those that are accurate and sensitive enough are too delicate for field use. Those that are rugged enough for field use lack the necessary sensitivity. What is required is a micro-manometer which will measure differentials as low as 2 or 3 thousandths of an inch water column, accurate to a ten-thousandth of an inch, and rugged enough to be used by comparatively unskilled workers under field conditions. *Fig. 2* shows such an instrument. It is called a tilting micromanometer. It is in reality a modification of the ordinary U tube. Glass reservoirs are substituted for the arms of the tube. Instead of reading the height that the liquid travels up or down the tubes, one leg of the tube is raised or lowered so that the liquid line returns to its former position relative to the tube. Instead of reading the movement on an ordinary rule, the measurement is taken on a micrometer wheel. The meniscus is observed through a microscope instead of by the unaided eye.

The lower section of the instrument is a trivet upon which the tilting bar is mounted. Adjustment screws

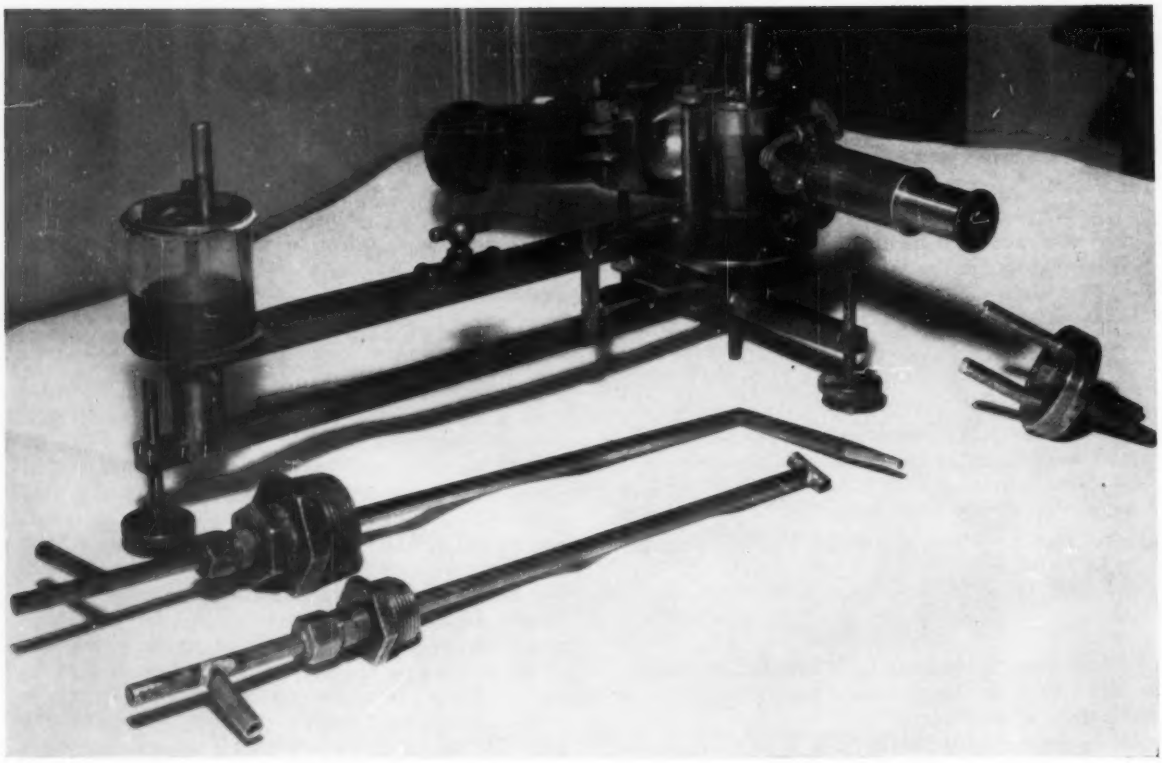


Fig. 3. From top to bottom: The Micromanometer, the standard Pitot tube, and the doubled-ended Pitot tube. The reversal cock is at right.

J are used for lateral levelling. Adjustment screw K is used for adjusting the level of the whole instrument so as to bring the meniscus under the hairline in the microscope while the micrometer wheel A is set at zero.

The reservoirs F are made of oil gauge glasses, approximately 2 in. in diameter and 2 in. long, with sidewalls about 3/16 in. thick. They are clamped between brass discs with suitable gaskets. Microscope D is of the low power variety which normally sells for around $5. It is necessary to grind and polish a flat face on one of the reservoirs because the thickness of the glass is greater than the focal length of the microscope. Any glass shop that bevels mirrors can do this job. The flashlight E is mounted and adjusted so that it illuminates the meniscus under the microscope. The best position is generally a little below the liquid level, tilted so the light beam strikes up from below at a slight angle.

The thread of the micrometer A is cut with 20 turns to the inch and the wheel is calibrated so that 1/5 revolution equals 1/100 in. Each hundredth of an inch division is further divided into tenths, representing thousandths of an inch. Scale B counts the revolutions, much the same as an ordinary micrometer calliper. The wheel must be placed directly under the center of the reservoir. Otherwise a correction for the angular error would have to be made to the readings. Cock H is used only while transporting the instrument so as to help to prevent the liquid from spilling.

The instrument is a rugged counterpart of a laboratory instrument made of blown glass parts and suspended upon hardened steel knife edges with reflected light for illumination. The additional ruggedness is gained without a measurable loss of accuracy. For reasons which will be explained later, if it is planned to measure gas or air at low velocities two micromanometers will be required.

The micromanometer need only be used for readings under ½ or at the most ¾ in. liquid column. The sloping tube manometer, available from almost any scientific supply house, will give results accurate enough for readings between ½ in., and say, 2 in. liquid column. The U gauge can be used for readings from 1 in. wc, and up.

To obtain clear, accurate readings, the glass in the manometer must be immaculately clean. The slightest trace of contamination on the glass causes the meniscus to hang up and distort, resulting in false readings. Some of the lighter hydrocarbons, such as benzene, toluene, or even commercial gasoline, give much better results than water. They have a lower surface tension, and keep the glass much cleaner. Whatever liquid is used it will be necessary to color it. Otherwise, in the microscope you cannot tell whether you are looking at a clear liquid or the air above it. It is all the more confusing because the

image is inverted. Liquids of suitable properties, already colored and with a declared specific gravity prepared especially for manometers, can be procured from most scientific supply houses. A secondary advantage gained from using liquids lighter than water is that the heads to be read are proportionally greater.

Incidentally, nearly every text on Pitot tubes shows a manometer which employs the difference in specific gravities between two non-miscible fluids to effect magnification of the readings. Yet, when it is realized that each fluid soils the glass for the other, it will be seen that this type of manometer is fundamentally impractical. Experiments have proven it to be so.

• The reversal cock

One more piece of apparatus is needed before attempting to take Pitot readings under pressure.

The micromanometer, unlike the U tube, must be set to zero ahead of each reading. It is impractical to disconnect the instrument or remove the Pitot tube from the pipe before each reading. So a special cock has been devised which allows the manometer to be adjusted while it is connected. It is called a reversal cock and is made of two brass discs 2 in. in diameter lapped together and pivoted from their centers. Two holes are drilled in each in such a way that the holes in one disc line up with the holes in the other before and after rotating one of the discs through 180 deg. Pieces of 5/16-in. tube are soldered into all four holes so as to form connections for rubber tubes. The reversal cock is inserted in the rubber tubes between the manometer and the Pitot tube. Its use will be covered later.

• Taking the readings

The following procedure will be found practicable for taking velocity readings in low pressure mains.

If the line in which the flow is to be measured happens to be a buried gas main, select a stretch that is straight and clean for at least 20 pipe diameters each way from the Pitot tube. Bare the pipe, and tap it with a standard pipe thread, large enough to accommodate the Pitot tube. Mount the manometer on a FIRM base near the side of the ditch. The emphasis on "firm" will be appreciated when it is realized that a movement of the instrument amounting to one thousandth of an inch will upset the readings. One way is to lay a 2-in. x 12-in. plank across the hole and weight each end by piling earth or sand bags across the ends. Set up and level the manometer. Insert the Pitot tube in the main and connect both outlets to the manometer using a good quality of impervious rubber tube, with the reversal cock connected between the Pitot tube and the manometer. Try to avoid blowing gas through the Pitot tube. Rather than clearing it, gas is more likely to plug it. Turn on the flashlight, open cock H, open the reversal cock so as to connect the manometer right through to the Pitot tube, and set the micrometer wheel to zero. Bring the meniscus under the hairline in the microscope by adjusting levelling screw K.

Convex mirrors have a tendency to reflect sources of light of any shape as long, narrow bars of light. The underside of the meniscus acts as a convex mirror and reflects the light from the flashlight as a number of bright and dark streaks. A suitable line can be selected and used as the reference. A little manipulation of the angle of the flashlight will change the pattern of the streaks until a suitable line is formed. Once the light is adjusted it will hold its adjustment throughout any number of readings without resetting.

Once the reference line is under the hairline, test for leaks in the tube connections. No leak, however small, can be tolerated. Where there is a leak, there is flow. Where there is flow there is friction, and where there is friction there is loss of head. When the total reading may be only two or three thousandths of an inch even the slightest loss in head cannot be tolerated. Even porous rubber tubing can render readings useless. The following method can be used to test for leaks quickly and accurately.

Pinch one rubber tube where it joins the Pitot tube, and watch the meniscus under the hairline in the microscope. If it creeps it means that there is a leak between the manometer and the pinch in the tube. When the liquid shows no leakage, pinch the opposite tube and again observe the hairline. Then test the actual connections to the Pitot tube with soap suds or saliva. The instruments are then ready for use.

Position the Pitot tube in the center of the pipe with the nozzle facing upstream, and then open the reversal cock. The velocity of the gas impinging on the Pitot tube will force the meniscus either up or down. It does not matter which. Leave the micrometer wheel set at zero, and bring the reference line in the meniscus back under the hairline by adjusting levelling screw K. Now, although the instrument is reading zero, it is actually registering the full velocity head for the velocity being measured. Then reverse the reversal cock. This will force the meniscus to travel through two velocity heads, from full elevation to full depression or vice versa. Return the reference line in the meniscus back under the hairline in the microscope by turning the micrometer wheel A. When the two line up exactly as they did before reversing the cock, read tenths of an inch from scale B, and the hundredths and thousandths from the micrometer wheel, scale A. Write this reading down, but remember, it is a double reading, and must be halved before used in the calculations. Several things can happen during a reading. A movement of the instrument or a change in the gas velocity can render the reading invalid. The reading can very easily be checked by returning the reversal cock to its original position, and, with the eye to the microscope, returning the meniscus to its original position. If the micrometer wheel does not indicate zero when everything is returned to its original position, the reading should be rejected and another taken.

This system of setting, reversing, reading, reversing again and checking, takes very little extra time. It not only renders double readings which reduces errors of inspection by half, it automatically culls

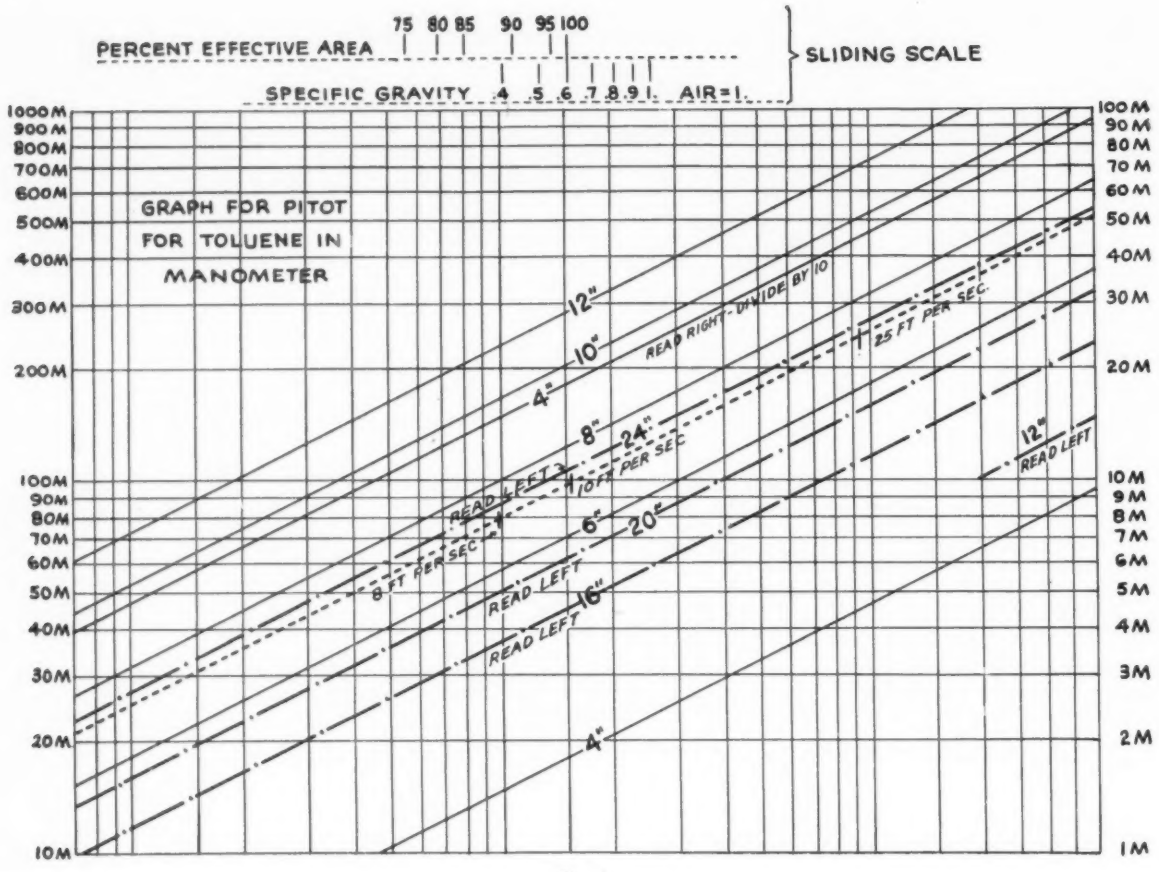


Fig. 4

out all false readings which might otherwise confuse the operator.

The whole operation is really quite simple. Experience has shown that even unskilled workers can take repeated readings accurate to less than 1/1000-in. wc, after only about 15 minutes instruction and practice.

The readings for low velocities, as was shown earlier, are in the nature of a few thousandths of an inch. The use of a hydrocarbon instead of water, the reversal cock, and Pitot tubes with coefficients greater than 1 all tend to magnify the readings. Assuming that toluene with a weight of 54.96 lb. per cubic foot, and a Pitot tube with a coefficient of 1.2 were used, the magnification of the reading would be as follows:

From reversal cock	2
From toluene instead of water	1.13
From Pitot coefficient	1.2
$2 \times 1.37 \times 1.2 = 2.71$	

The velocity head as measured for air at 5 ft. per second would therefore be 2.71 x .0057 in. or .0154. Even greater magnifications are possible with Pitot tubes with higher coefficients. In fact, one manufacturer advertises a Pitot tube with a coefficient of 10.

Since velocities in high pressure mains are generally much higher, an assembly comprised of a double-ended Pitot tube, two pieces of pressure hose, and a U gauge will generally be found to give sufficiently accurate readings. The Pitot tube can be withdrawn and inserted through a corporation cock without loss of gas. If the readings are too small for accurate reading with an ordinary U gauge, the sloping tube manometer can be used. By using a double-ended Pitot tube, double readings can be taken and checked as before simply by turning the Pitot tube instead of reversing a reversal cock.

• Converting velocity to flow

If the flow of gas in pipes were frictionless and if gas had no viscosity, it would have a uniform velocity over the entire cross section of the pipe. Since gas is influenced by friction and viscosity, the rate of flow across the pipe is far from uniform. In fact, there is a thin layer of gas next to the pipe that can be considered to be stationary, with successive concentric layers slipping over each other, reaching a maximum velocity in the center. The shape of the front varies with the size and condition of the pipe, rate of flow and whether the flow is laminar or turbulent. Before the volume flowing can be calculated, the average velocity of the gas must be determined. This can be done by taking a number of readings across the pipe and plotting the shape of the front. A better

way is to divide the cross section into 10 concentric circles of equal areas numbered from 1 to 10 beginning at the center, the tenth circle being the pipe. The Pitot tube is placed successively at the odd numbered circles. The radial distances of the points will be

$$R\sqrt{.1}, R\sqrt{.3}, R\sqrt{.5}, R\sqrt{.7}, \text{ and } R\sqrt{.9}$$

where R is the radius of the pipe. The arithmetical mean of the velocities can be assumed to be the average velocity within the pipe. Even when this is done it is wise to take a complete traverse across both halves of the pipe to make sure that the flow pattern is symmetrical.

If velocities were to change during the traverse, under ordinary circumstances it would not be noticed and a false average velocity would result. This is where the second micromanometer comes in. The best and surest way of knowing if the velocities do change during a series of readings is to have a second complete Pitot tube and micromanometer installation a few feet along the pipe and for the operator to keep check on the center velocities during the test.

Once the average velocities for a series of different center velocities have been determined for each size of pipe, graphs can be plotted, and only center velocities taken from then on. It is a comparatively simple matter to take accurate velocity readings, but large errors can creep in if care is not used in determining and applying the average velocities.

• Calculations

It was shown earlier that velocity can be calculated from the velocity head by the formula

$$V^2 = 2gh \text{ or } V = \sqrt{2gh} \text{ when}$$

V is the velocity in feet per second

g is the gravitational constant 32.187

h is the velocity head in feet of the fluid being measured.

When the liquid in the manometer has a different specific gravity to the liquid being measured, it is necessary to correct for the difference in weights. For toluene it would be:

Weight of water at 60°F	=	62.368 lb per cu ft
S.G. of toluene .8812		
Weight of toluene at 60°F	=	54.96 lb per cu ft
Weight of air at 60°F	=	.07654 lb per cu ft
Weight of gas at 60°F	=	.07654 S lb per cu ft where S is S.G. of gas being measured, air = 1.

$$\frac{\text{Weight of toluene}}{\text{Weight of gas}} = \frac{54.96}{.07654S} = \frac{718}{S}$$

$$V = \sqrt{2 \times 32.187 \times \frac{718}{S} h} \text{ or } V = \sqrt{46220 \frac{h}{S}}$$

When H is measured in inches instead of feet this becomes:

$$V = \sqrt{3852 \frac{H}{S}} \text{ or } V = 62.6\sqrt{\frac{H}{S}}$$

It would be very tedious to have to calculate the velocity and volume for each velocity head separately, but fortunately any equation of the form $y = CX^n$ is a straight line when plotted on logarithmic paper, and n is the slope of the line. Therefore, the formula

$$V = 62.6\sqrt{\frac{H}{S}} \text{ or } V = 62.6\left(\frac{H}{S}\right)^{\frac{1}{2}}$$

will be a straight line when either H or S is constant, and the slope of the line will be $y = 2X$.

If the specific gravity of the gas is constant at .6, the velocity line will be as shown on the graph in *Fig. 4*. The volume flowing in a pipe can be calculated by the formula

$$Q = 3600 \text{ KVA or } Q = 3600 V \frac{K \pi D^2}{4 \times 144}$$

When Q is volume flowing in cu ft per hr

V is velocity in ft per second

D is inside diameter of pipe in in.

A is area of pipe in sq ft

K is equivalent effective area of pipe.

Since K is the only variable for any given pipe size and any given velocity, lines parallel to the velocity line can be drawn on the graph representing the volume flowing in cubic feet per hour, assuming K to be constant. The volumes flowing in any pipe for any velocity can then be extracted directly from the chart, requiring only correction for equivalent effective area.

It was stated earlier that the velocity line would be a straight line on the chart for any given specific gravity of gas. A number of velocity lines could be drawn, one for each specific gravity to be considered. This would require either a separate chart for each specific gravity, or a number of parallel lines on a single chart. If S were considered a multiplier of H, in other words, if a correction for specific gravity were made to the velocity head reading before it was applied to the chart, a single line would do. This can be done quite simply by making the graph with a sliding scale across the top. The sliding scale can be made of another piece of log paper pasted to a piece of cardboard, and held between a fold in the chart, or, if desired, the chart can be mounted on a board backing with a slide built into it (see *Fig. 4*).

If the scale for correcting for specific gravity can be placed opposite another scale which will correct for effective pipe area, the volume flowing can be read directly from the chart simply by following the velocity head reading on the sliding scale down the chart to where it intersects the proper pipe size. Two or more colors* can be used for plotting the lines with the black lines reading in thousands on the black scale at the right, and the red lines reading in tens of thousands on the red scale at the left. In this way, the effective area of the chart is doubled so that it covers the entire range from 2000 to 800,000 cu ft per hour.

The correction scale for S can be calculated as follows:

$$\text{When } S = .45, \frac{H}{S} = \frac{H}{.45} = 2.22 H$$

* For mechanical reasons, GAS eliminated the colored lines in the graph reproduced as Fig. 4. The solid lines read in thousands to the scale at the right. The dot-dash lines read in tens of thousands on the scale at the left.

$$S = .5, \quad \frac{H}{S} = \frac{H}{.5} = 2\,H$$

$$S = .6, \quad \frac{H}{S} = \frac{H}{.6} = 1.66\,H \text{ etc.}$$

The correction scale for effective area can be calculated as follows:

$$Q = CK\sqrt{H}$$

when C is a constant representing the theoretical volume.

When H = 1 this formula can be written

$$Q = C\sqrt{H\,(K)^2}$$

In this form K may be used as a multiplier for H, just as S was, and therefore the S scale can be set to the K scale instead of a fixed point.

$$1^2 = 1$$
$$(.95)^2 = .9025$$
$$(.9)^2 = .81 \text{ etc.}$$

The chart offers a quick and easy way of extracting readings for all velocity heads, specific gravities and percentages of effective area. Since all the readings will be in the form $Q = C\sqrt{H}$ or $V = C\sqrt{H}$, once the first reading has been extracted from the chart an ordinary slide rule can be used for taking the rest of the readings. H can be set on the B scale over the velocity or volume on the D scale. All other velocities or volumes can be found on the D scale under their velocity hands on the B scale by moving the cursor and without resetting the slide.

In fact, it may prove desirable for converting readings in the field to simply make a list of settings, one for each pipe size, in a note book and use a slide rule for converting the readings.

• Calculations for Pitot measurements under pressure

Going back to our formula $V = C\sqrt{\frac{H}{S}}$

Where V is the velocity of the gas
C is a constant containing all other constants
H is Pitot velocity head reading
S is specific gravity of gas, air = 1.

A compressed gas would act on the Pitot tube the same as a denser gas, and in the ratio $\frac{P_2}{P_1}$

When P_1 is base pressure, absolute
P_2 is actual pressure, absolute
The equation would then become

$V_1 = C\sqrt{\frac{H}{S\,\frac{P_2}{P_1}}}$ when V_1 is the velocity of a particle of compressed gas.

Treating S as a constant and including it in C this becomes

$$V_1 = C\sqrt{H\,\frac{P_1}{P_2}}$$

In other words, to obtain the velocity of a particle, simply solve $\frac{P_1}{P_2}H$ before applying H to the graph, and read the velocity of the particle directly from the graph. If it were more desirable to know what the velocity of the gas would be if the compressed gas were reduced to standard pressures, the velocity would have to be increased by the ratio $\frac{P_2}{P_1}$, so the formula would read $V_2 = \frac{P_2}{P_1}V_1$

Where V_2 = equivalent velocity of the same volume of standard gas. Substituting $C\sqrt{H\,\frac{P_1}{P_2}}$ for V_1, our formula becomes

$$V_2 = \frac{P_2}{P_1}C\sqrt{H\,\frac{P_1}{P_2}}$$

This can be simplified $V_2 = C\sqrt{\frac{H \times P_1}{P_2} \times \frac{P_2}{P_1} \times \frac{P_2}{P_1}}$ or

$$V_2 = C\sqrt{\frac{H \times P_2}{P_1}}$$

The equivalent velocity of the same volume of gas reduced to standard pressures can therefore be read directly from the velocity line on the graph by simply solving $\frac{P_2}{P_1}H$, before applying H to the graph.

The volumes of gas as compressed or gas at standard pressures can also be taken from the chart by solving the equation

$Q_1 = V_1AK$ for volume of compressed gas
or $Q_2 = V_2AK$ for volume of gas reduced to standard pressures.

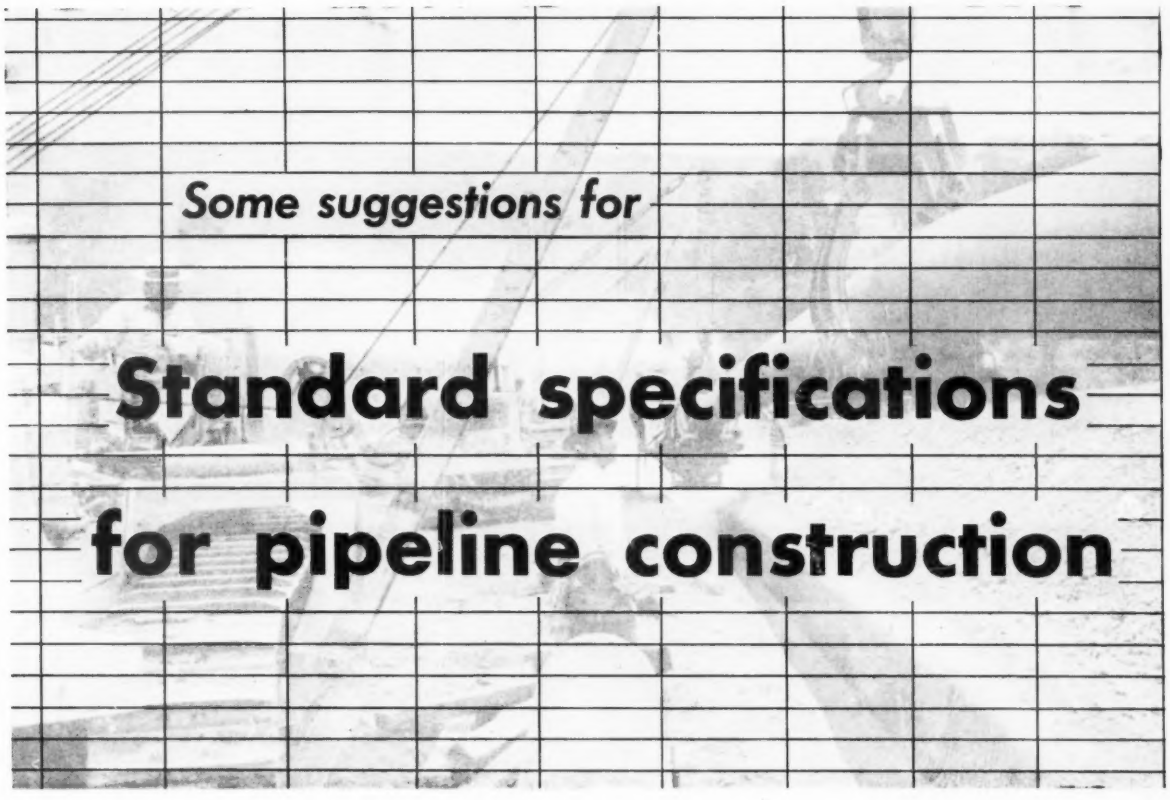
In other words, the volume lines on the graph can still be used by adjusting the value of H before applying it to the graph.

Throughout the calculations reference has been made to compressed gas. The same formulae apply equally well to gases at less than standard pressure. No reference has been made to temperature correction because it is probable that most gas measurements would be taken on pipes in the ground where temperatures do not fluctuate much from day to day. A number of graphs could be drawn to cover various temperatures, or again, H could be corrected for temperature by the formula $\frac{T_1}{T_2}$ where

T_1 is the standard temperature, absolute and
T_2 is the actual temperature, absolute.

Since the effect of an increase in temperature is the opposite to an increase in pressure $\frac{T_1}{T_2}$ could be substituted for $\frac{P_2}{P_1}$ wherever it appears in the formula or used along with it as $\frac{T_1}{T_2} \times \frac{P_2}{P_1}$ if correction for temperature and pressure were required simultaneously.

The graphs and calculations shown in the text are offered only as a guide. Each experimenter should make his own calculations and draw his own graphs, making the necessary correction for local conditions. For instance, it may be desirable to correct for supercompressibility, moisture content, and so on. It will be found in general, that such corrections are quite simple when applied to the specific gravity, and used as a correction factor for H. ■



Some suggestions for

Standard specifications for pipeline construction

By H. M. McCAMISH, Pipeline Division Manager
Mountain Fuel Supply Co., Rock Springs, Wyo.

MOST pipeline companies have a gas pipeline construction specification which they have developed over a period of years to cover the items which they feel are essential. This specification is usually modified for each new job to meet its specific needs. It has been my experience, however, that each company tends to deal at great lengths with certain phases of the construction while only briefly mentioning or virtually ignoring phases which are equally important. This undoubtedly reflects the past difficulties which the particular company has experienced.

For some years now, I have felt that the industry needs a "Standard Basic Specification for Gas Pipeline Construction" which any company could use with the assurance that all essential construction requirements had been fully covered. The "Specification #1000," which is presented here, is a preliminary attempt to develop such a specification.

Since there are always unique requirements in any given pipeline job, the "Standard Specification" must be used in conjunction with a document which spells out the special construction details for the given job. I have chosen to call this instrument "Construction Data." Any number of other designations might be equally suitable. Construction Data also provides a place to specify those items which are not a matter of standard practice, such as the width of right-of-way provided, type of welding rod to be employed, type of coating to be used, depth of cover required, etc. Each Construction Data has a number which is specific for the particular job.

Most of the items in Specification #1000 are based on accepted practice within the industry. This is not to say that all of the items would be acceptable in their present form to all companies, but I believe that the great majority would be acceptable to most companies. Certain items must definitely be considered controversial, however. This points up the need for further work on the "Specification" by qualified persons from many different companies. I would like to suggest that this would be a very worthwhile project for the American Gas Association to undertake by forming a special committee to develop a generally acceptable "Basic Specification for Gas Pipeline Construction." Such a committee should certainly include, in addition to pipeline company people, representatives of the pipeline contractors and of the pipeline material manufacturers.

In addition to the Specification #1000, a sample of a "Construction Data" is also presented in this article to illustrate clearly the function of this document and how it relates to the "Standard Specification."

Specifications begin on page 120

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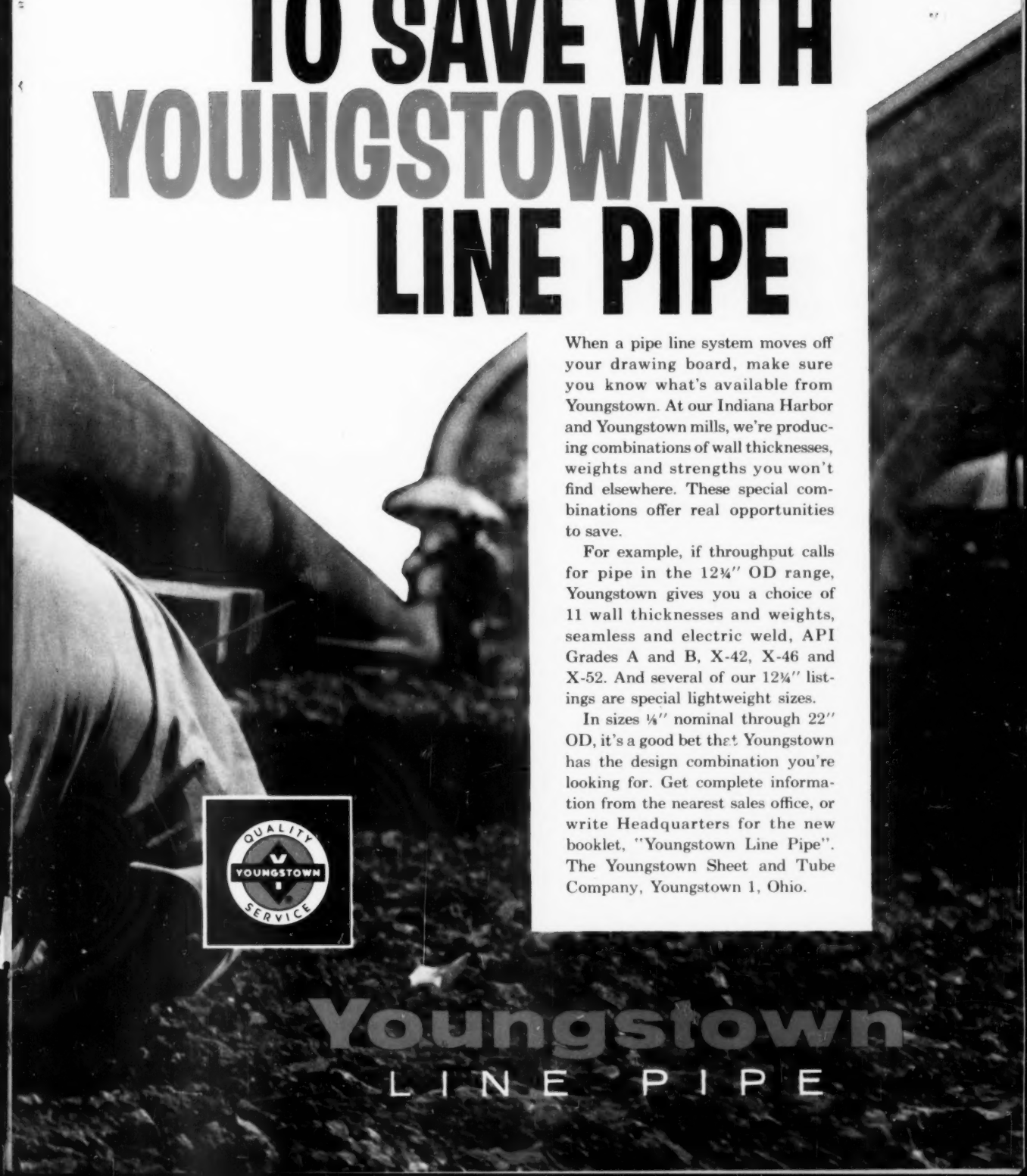

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LINE PIPE

CONSTRUCTION DATA

1 Scope: This Construction Data covers the proposed installation of approximately 55.5 miles of 24-in. wrapped, welded, steel pipe from company's Valve House No. 10 near Elk Creek, Bridger county, Wyo. (Mile Point 210.40) to company's Gasville station near Gasville, Alpine county, Utah (MP-265.90).

1.11 Prevailing Specifications: This Construction Data includes and is supplemented by Specification #1000, Pipeline Construction dated June 15, 1959. In case of conflict, between Construction Data and Specification #1000, the provisions of CD shall prevail.

1.12 Supplementary Exhibits: The following exhibits attached hereto are a part of this Construction Data:

Exhibit A: Specification #1000

Exhibit B: Route Maps (10 sheets)

Exhibit C: Drawing No. VA-10-3 showing details of valve assembly at Valve House No. 10.

Exhibit D: Drawing No. VA-14-5 showing details of valve assembly at Valve House No. 14.

Exhibit E: Drawing No. VA-15-3 showing details of valve assembly at Gasville station.

Exhibit F: Drawings No. RC-559-1 through No. RC-559-9 (9 sheets) showing details of road crossings.

Exhibit G: Drawings No. CC-560-1 through CC-560-14 (14 sheets) showing details of creek crossings.

Exhibit H: Drawing No. PW-74-1 showing details of pipe wrapping.

2. Rights-of-Way and Other Property

2.1 Rights-of-Way: The right-of-way provided shall be 50 ft in width and shall be defined as lying 40 ft northerly and 10 ft southerly of the centerline of the proposed pipeline.

2.3 Damage: The proposed construction is located on land covered with grass, low brushwood, and other dry vegetation easily ignited. Contractor shall provide his crews with sufficient approved fire fighting equipment to provide adequate fire protection.

3. Pipeline Materials: Company will supply the following materials at its Gasville station:

Pipe: Approximately 55.5 miles (293,000 ft) of 24 in., 0.312-in. wall, X-46, fusion welded, cold expanded, bare pipe weighing 78.9 lb per lineal foot, in nominal 40 ft lengths.

Bends: 90 deg. weld ells, standard weight, 3-R.

Wrapping materials: Approximately 850 tons of fully plasticized coal tar enamel; 3500 gal. of coal tar primer; 18,000 squares of 18-in. width fiberglass wrap; 18,000 squares of 18-in. width, 15-lb coal tar-impregnated asbestos felt wrap, and 500 squares of rock-shield.

River Weights: 4500-lb concrete river weights as required.

Miscellaneous: Small fittings, paint, and miscellaneous materials as required.

4. Special Construction Requirements:

4.1 Procedures

4.11 Sequence of work: In order to allow the harvest to be completed on the cultivated lands near Elk Creek, the work will start at the westerly end near Gasville and proceed toward the easterly end near Elk Creek.

4.2 Installations

4.21 Road and Rail Crossings: Unless otherwise specifically authorized by company's chief inspector, there shall be a tie-in weld immediately adjacent to, and on at least one side of, each road crossing.

4.22 River and Canal Crossings: Unless otherwise specifically authorized by company's chief inspector, there shall be a tie-in weld immediately adjacent to, and on at least one side of, each river crossing. Company shall furnish and contractor shall install river-weights as indicated in Exhibit G.

4.24 Auxiliary structures: Company will install valve assemblies shown in Exhibit C, D, and E. Contractor shall connect the pipeline to these valve assemblies as indicated in these exhibits.

5. Hauling and Stringing: Pipe shall be strung so as to provide approximately 15 ft of overlap at tie-in points.

6. Trenching

6.1 Depth of Cover: The trench shall be of sufficient depth to provide a minimum cover of 42 in. in cultivated sections and 30 in. otherwise as indicated on route maps, while meeting all other construction requirements, such as the pad required below the pipe, requiring slack in the pipe section, etc.

6.2 Character: The trench shall not be less than 34 in. in width.

7. Welding

7.2 Test of Welders: All welders shall be required to pass welding tests before starting work on the line.

7.3 Methods and quality of welding

7.32 Electric Arc Welding: The rod used for the stringer bead shall be Fleetweld No. 5 or equivalent brand approved by company's chief inspector and shall be 5/32 in. diameter. The rod used for the hot-pass shall be Fleetweld No. 85 or equivalent brand approved by company's chief inspector and shall not be larger than 5/32 in. in diameter. The rod used for the filler beads shall be of the same type used for the hot-pass and shall not be larger than 3/16 in. in diameter. The rod used for the cap bead shall be Fleetweld No. 5 or equivalent brand approved by company's chief inspector and shall not be larger than 3/16 in. in diameter.

7.4 General welding procedure

7.43 Tie-in welds: Tie-in welds are to be completed before 10 a.m. unless otherwise agreed by company's chief inspector. The maximum distance between tie-in welds shall not exceed 3000 ft. Sections of pipe which are cut off at tie-ins shall be subsequently welded into the pipeline provided they are not less than 10 ft in length.

8. Protective coatings

8.2 Handling: Freshly coated pipe shall be set on skids overnight to allow cooling and inspection and will consequently not be lowered into the trench until the following morning. Before pipe is lowered into the ditch, all skid damage to coating shall be repaired by contractor.

8.3 Wrapped coatings: Contractor shall apply over the trench the wrapped coating specified in Exhibit H to all pipe which is to be buried.

8.4 Bare sections: Exposed pipe shall be painted with one coat of chromate primer and one coat of W. P. Fuller Fulumina #9836 or equivalent approved by company's chief inspector.

9. Laying and lowering

9.3 Lowering: All pipe sections shall be lowered in the early morning so that the tie-in welds can be completed as specified in Section 7.43.

10. Completion tests

10.1 "Stand-up" test: The pipeline will be tested with gas to a test pressure of 1040 psig. The compressor and other equipment required for performance of the test shall be provided and operated by the contractor. The company will provide the gas for testing from its existing pipelines at a pressure of not less than

500 psig and will provide the recording pressure gauge.

10.2 Scraper test: Contractor shall run a scraper or pig through all sections of the line unless otherwise authorized by company. Company will supply the scraper or pig to be used.

11. Clean-up

11.1 Surplus material: All surplus material equipment, and other property belonging to company shall be returned by contractor to company's Gasville station.

STANDARD SPECIFICATION 1000

1. Scope

This specification covers the general requirements for construction of welded steel pipelines. Details concerning both the materials and construction of any specific pipeline are provided in a particular specification applying to that line, herein referred to as CONSTRUCTION DATA (CD). The specific instructions of this supplementary CD shall prevail over any conflicting provisions of this specification.

2. Rights-of-Way and Other Property

2.1 **Rights-of-Way:** Company shall furnish the land or rights-of-way on which the pipeline shall be located and the stakes necessary to guide the construction work on the ground. Company shall obtain all permits necessary for the routing of the line. Essential arrangements to cross property, traverse roads, or pass through gates to reach the right-of-way shall be made with the owners or proper authorities by company before contractor shall enter thereon. Contractor shall arrange for any additional means of ingress or egress he may desire.

2.2 **Fences:** Wire gates, to be installed where fences cross the right-of-way, will be furnished by the company and installed by the contractor. In the installation of these gates the original tension in the fence wires shall be maintained. Posts shall be installed and the fence wires securely fastened before the fence is cut. Watchmen shall be maintained wherever gates are left open.

2.3 **Damage:** All construction activities, including the stringing of pipe, shall be confined to the width of right-of-way specified in CD whenever practicable. Contractor's operation shall be so conducted that a minimum of damage and inconvenience is caused to the public and to the owners and tenants of property affected by the construction work. Contractor shall cooperate with company's chief inspector in satisfying all reasonable requirements of property owners. Contractor shall be responsible for any damage whatsoever incurred off the specified right-of-way.

2.31 **Company Facilities:** Contractor shall be responsible for any damage to existing pipelines, telephone lines, or other facilities maintained by the company whether within or outside of the specified right-of-way.

2.32 **Other Utility Facilities:** Contractor shall be responsible for any damage to power lines, telephone lines, or pipelines owned by other parties whether within or outside of the specified right-of-way.

2.33 **Livestock:** Contractor shall pay for or repair all damages done to or by any livestock which escape through any fence or gate left open or insecurely closed and for any damage to livestock resulting from performance of the work.

2.34 **Company's Liability:** Except as provided in the two paragraphs immediately preceding, surface damages, such as to crops within the specified right-of-way, shall be paid for by the company, but only to the extent such damage was necessary for performance of the work in a reasonable manner without negligence.

3. Pipeline Materials

The contractor shall furnish oxygen, acetylene and welding rods, together with welding equipment. Unless otherwise specified in CD DATA, company shall furnish pipe, fittings, and all other materials to be incorporated in the pipeline, at the times and locations designated in CD. Contractor shall be responsible for proper handling and storage of materials provided to him by company.

4. Special Construction Requirements

4.1 **Procedures**

4.11 **Sequence of Work:** The work may proceed in the sequence most convenient to the contractor consistent with the completion of the project on or before the completion date specified in the contract unless otherwise specified in CD.

4.12 **Extra Work:** Except for items of work specifically designated herein as **extra work**, contractor's compensation for pipeline construction includes compensation for all work required for the construction of the pipeline according to this specification. Contractor shall be compensated for any extra work required by company by mutual agreement between company and contractor reached previous to performance of such work. Any such extra work shall be performed only after written permission is received from the district pipeline superintendent. The amount of compensation mutually agreed upon will be included in the text of the written permission. Company may, at its discretion, elect to perform any additional work not included in CD.

4.13 **Safety:** Contractor shall employ only safe methods in the construction of this pipeline so as to cause no undue hazard to the public or to contractor's personnel. Lanterns, barricades, warning signs, and other safety devices shall be maintained in sufficient number. The company reserves the right to halt construction at any time that, in the opinion of the company's chief inspector, unsafe methods are employed.

4.14 **Measurement:** Measurement of the pipeline for the purposes of determining compensations designated in the contract as "per linear foot" will be by slope chaining in accordance with company's inventory survey of the line.

4.15 **Personnel:** In their contacts with the public it will be necessary for contractor's personnel to conduct themselves in such a manner that they should not bring criticism to company. Company reserves the right of demanding the removal of any employee whose conduct does not, in the company's opinion, comply with this standard.

4.2 **Installations**

4.21 **Road and Rail Crossings:** All road and rail crossings shall be made to conform to the requirements of the state highway commission, county road commission, railroad company, or other authority having control over the right-of-way crossed. Where specified in CD, a casing or pipe large enough to accommodate the pipeline shall be installed under the right-of-way crossed.

4.211 **Boring:** Except where ditching across the right-of-way crossed is permitted, the casing shall be installed by boring and jacking. If the casing is

installed in an embankment, the ends of the casing shall extend out from the embankment when required. The section of the line to be placed in the casing shall be welded into one piece and tested as provided in CD before being inserted. The section of the line shall be inserted into the casing without injury to any protective coating.

4.212 **Road Surface:** At any time it is necessary to cut paved or oiled portions of any highway, road, or street, company will obtain necessary permission from the proper authorities. It shall be the contractor's responsibility to notify company sufficiently in advance of construction to permit normal processing of the permits. Any removed pavement or road surface shall be repaired by contractor to the satisfaction of the state highway commission, county road commission, or other authority having jurisdiction. Backfill material shall be tamped in accordance with Section 10.4.

4.22 **River and Canal Crossings:** Any special specifications for river and canal crossings are given in CONSTRUCTION DATA.

4.23 **Installation Above Ground:** Where so directed, the pipeline shall be installed above the ground on trestles, blocks, or other supports constructed in accordance with plans furnished by company. Unless otherwise specified in the contract, compensation for placing pipe on supports above ground shall be the same as for laying it in the ground. Construction of the supports, if not required in CONSTRUCTION DATA, shall be **extra work.**

4.24 **Auxiliary Structures:** The contract price includes compensation for installing drips, bleeders, valves, flanges, motors, and other minor items of equipment. Company shall furnish designs, specifications, and locations for all such equipment involved in CD. Company shall also furnish designs and specifications in CD for trestles, anchors, auxiliary structures, etc., which the contractor is to install.

5. **Hauling and Stringing**

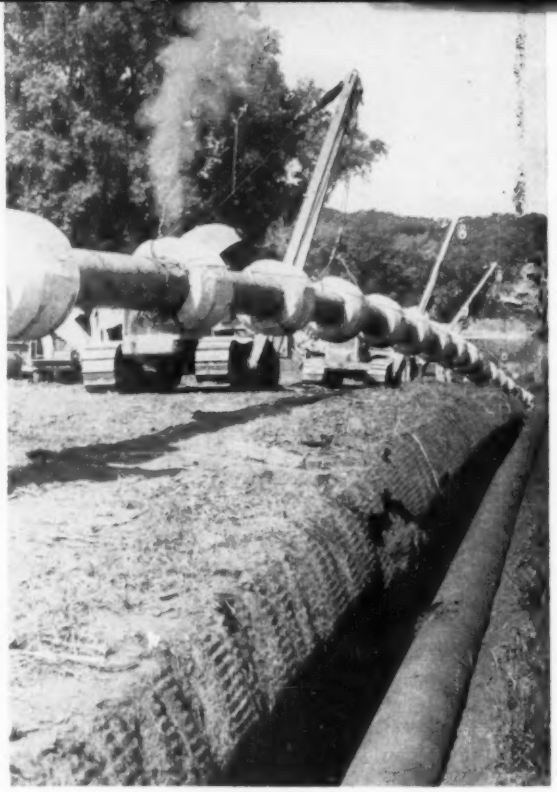
Pipe shall be loaded, hauled, and unloaded in such a manner as to prevent permanent deformation or scarring of the pipe or any other damage. Pipe slings will normally be used and these will be provided with flat-faced hooks with long, narrow throats. Special care shall be taken to see that the pipe is not bumped against objects during handling. Pipe shall be strung so as to require a minimum amount of shifting for proper line-up.

6. **Trenching**

6.1 **Depth of Cover:** The trench shall provide "depth of cover" between the top of the pipe and the main surface of the ground sufficient to insure the minimum cover specified on route maps or in CD. The trench shall be deeper when the pipe must pass under substructures not anticipated therein. Where solid rock is encountered, company's chief inspector may authorize a reduction in the minimum coverage.

6.2 **Character:** The trench shall be smooth, even and free of debris of any kind when pipe is laid. It shall be of sufficient width to permit laying the pipe without injury to pipe or to protective coatings or as specified in CD. Tree stumps and roots shall be cut back to provide a full trench width.

6.3 **Special Cases:** In the banks of canals, streams, washes, and gullies which company's chief inspector decides should not be spanned, the trench shall be dug to the depth necessary to give a proper slope from the lowest point to the top of the bank. Known underground structures are shown on route maps with instructions for crossing. Company's chief inspector will designate whether the pipe is to go over or under any underground structures encountered which are not on the route map. In no case will the pipe be allowed closer than 6 in. from any other structure. The trench will



also be deeper where necessary to provide proper approaches to road and rail crossings.

6.4 **Open Trench:** The length of open trench shall be kept as short as practical and in no case shall exceed 1000 ft on roads. When the trench is excavated through lands where livestock is confined or through cultivated field where access is required, contractor shall provide safe, temporary bridges for crossing the trench where necessary. Provision shall also be made by contractor for the passage of irrigation waters across the trench where required.

6.5 **Blasting:** Where blasting is necessary contractor shall exercise care so as not to scatter rocks and dirt outside the right-of-way or otherwise damage property. Contractor shall inform company's chief inspector previous to any blasting so that he may be present when the blasting is being done.

7. **Welding**

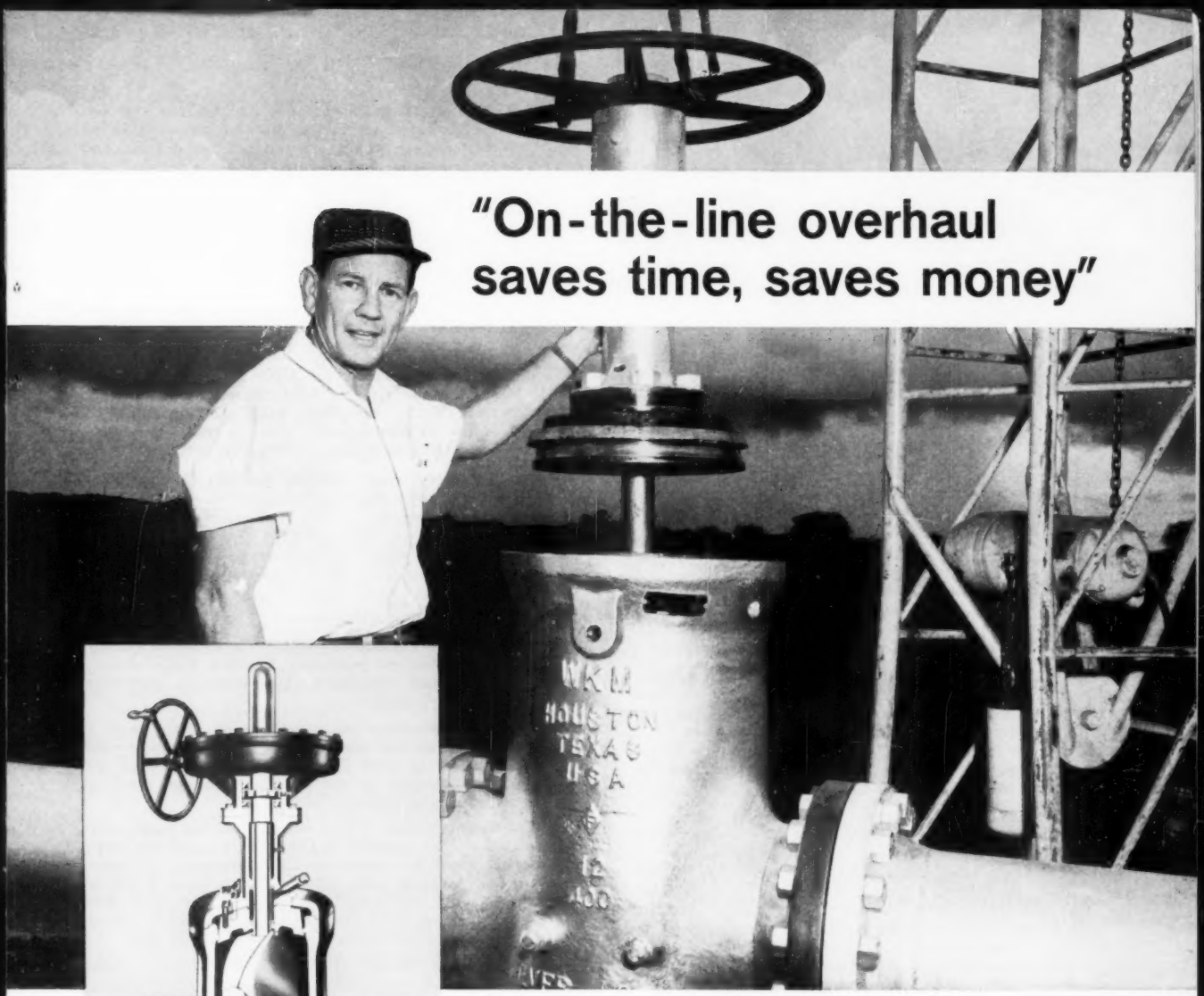
7.1 **Repairing and Care of Pipe:**

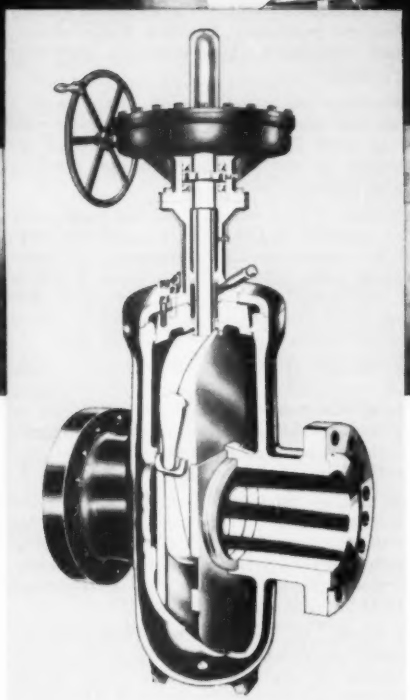
7.11 **Interior:** Each length of pipe shall be thoroughly examined inside to make sure that it is free from dirt, animals or other obstructions. If obstructed in any way, the pipe shall be swabbed out before being incorporated in the line.

7.12 **Ends:** The ends of the pipe shall be thoroughly cleaned of rust, scale, dirt, grease, protective coating or other foreign matter which might affect the quality of the welds. The ends of unbeveled pipe shall be beveled with a torch to an angle of approximately 30 deg. to the plane at the end of the pipe. The beveling shall be done in workmanlike manner and the finished cut shall be even, clean, and free from scale. Should laminations or split ends be detected during welding, contractor shall remove the defective sections from the pipeline in the same manner specified in Section 7.34.

7.13 **Unattended Section:** Open ends of sections of pipe, when unattended, shall be effectively closed or plugged.

"On-the-line overhaul saves time, saves money"





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7.2 **Test of Welders:** At the option of the company's chief inspector, welders may be required to pass welding tests before starting work on the line. Time spent by welders in taking these tests shall be paid for by contractor. Company shall furnish or pay for all equipment, material, and supervision used in examination of welders.

7.3 **Methods and Quality of Welding:** The electric arc process shall be used for all welding except where the use of oxyacetylene process is authorized by company's chief inspector. Equipment and material shall be of type, capacity, and condition satisfactory to company's chief inspector. The welding shall, in addition to any requirements listed herein, meet the requirements of the latest edition of the American Petroleum Institute's "Standard for Field Welding of Pipe Lines," API Std. 1104. The type and size of welding rod to be used will be prescribed in CONSTRUCTION DATA.

7.31 **Oxyacetylene Welding:** Rod shall be of the type and size specified in CD. Tack welds and the beginning of the main weld shall be thoroughly reheated and fused into the main weld as the welding progresses.

7.32 **Electric Arc Welding:** Rod shall be of the type and size specified in CD. Tack welds and each bead of all welds shall be peened and brushed clean of slag, scale and oxides before the succeeding bead is laid. Welds shall be made in at least three beads. Additional beads shall be laid if necessary to complete the reinforcement prescribed in Section 7.331. There shall be no more bellhole welds than absolutely necessary for going under substructures and street crossings, or for tie-ins. The pipe shall be swabbed out and welded over the ditch wherever possible.

7.33 **Details of Welds:** The following details apply to both the oxyacetylene and the electric arc processes.

7.331 **Reinforcement:** Welds shall be built up until the thickness at all points is not less than 1/32-in. greater nor more than 1/16-in. greater than that of the pipe. The width of the cover bead shall be slightly wider than the width of the groove.

7.332 **Defects:** Finished welds shall be free from undercutting at the edges, pinholes, nonmetallic inclusions, air pockets, rivers, or other defects, and shall be thoroughly fused into the pipe. There shall be no noticeable "humps" in the stringer bead. Small humps may be removed by use of a chipping hammer if authorized by company's inspector, but large humps shall be cause for rejection of the weld as unsatisfactory. No welds shall be calked or "doctored" with a torch.

7.333 **Penetration:** Full penetration shall be secured without allowing the metal to run inside the pipe. The inside of the pipe shall be free of protrusions.

7.334 **Striking of Arc:** The arc shall not be struck outside the area of the finished weld. Striking marks on the surface of the pipe outside the area of the completed weld shall be cause for rejection of the weld as unsatisfactory.

7.34 **Defective Welds:** Welds considered unsatisfactory by company's inspector shall be cut out of the line by contractor. Where sections cannot be properly lined-up by local shifting of sections after the removal of a defective weld, contractor shall install a short piece of pipe not less than 12 in. in length.

7.4 **General Welding Procedure**

7.41 **Weather Conditions:** Welders working in stormy weather shall be protected. Welding shall be suspended when company's chief inspector considers the weather unfit.

7.42 **Tack Welding:** Any tack welds shall have a thickness of not over two-thirds of the pipe wall and shall be free from defects. Joints shall be placed together in correct alignment and position with a gap of approximately 1/16 in.

7.43 **Tie-in Welds:** Tie-in welds shall be made only at the times specified in CD, except in specific cases authorized by company's chief inspector. In cases where tie-in at other times than specified in CD is authorized, additional slack shall be introduced into the line to the satisfaction of company's chief inspector.

7.44 **Marking Welds:** If required by company, contractor shall supply each welder with an identifying steel stamp or other marking device with which to mark every weld. A list of these identifying marks shall be furnished company's chief inspector and shall be kept up to date by contractor.

7.45 **Removal of Sections for Testing:** Contractor shall cut out and deliver to company's chief inspector for testing any section of the line including a weld which company's inspector may designate. Contractor shall then reweld the line as specified in Section 7.34.

7.451 **Weld Tests:** All welds tested after removal will be tested by company by bending or pulling to destruction as specified in API 1104. Welds shall have satisfactory penetration and shall show satisfactory homogeneous structure without evidence of porosity, slag or oxide inclusions or failure of welding metal to bond to base metal.

7.452 **Payment for Testing:** If the welds tested meet the requirements specified in Sections 7.33 and 7.451 and any other requirements specified in CD, company shall pay for removing the section and rewelding the line except that company may have one weld of each welder removed without cost to company regardless of test results. If the welds are unsatisfactory, contractor shall pay all such costs.

7.46 **Non-Destructive Testing:** Company will at its discretion employ X-ray or other non-destructive devices to inspect all or any desired sampling of

the welds previous to the coating operation. Any welds considered unsatisfactory by company's inspector as a result of such testing will be removed as specified in Section 7.34.

8. **Protective Coatings**

8.1 **General:** All pipe shall be coated and wrapped except for that pipe which will be above ground.

8.2 **Handling:** Care shall be taken in handling coated pipe to avoid injury to the coating. When such pipe is being hauled proper padding shall be used between pipe and truck and between pipe and binder chain. Adequate precautions shall be taken by contractor during laying operations to prevent damage to protective coating. Any damage to the protective coating shall be repaired at contractor's expense.

8.3 **Wrapped Coatings:** Wrapped coatings as specified in CD shall be applied by contractor to all buried pipe or to field joints in the case of millwrap pipe.

8.4 **Bare Sections:** All sections of pipe which are exposed shall be thoroughly cleaned and painted as specified in CD.

8.5 **Testing:** After pipe has been wrapped and previous to lowering into trench, company will, at its discretion, test the wrapping with a holiday detector. Where the test indicates a break in the wrapping or where visual inspection indicates wrapping has been damaged by contractor, the wrapping shall be repaired at contractor's expense.

9. **Laying and Lowering**

9.1 **General:** The pipeline shall be constructed and laid in such a way that it will touch the bottom of the ditch at sags and clear the bottom of the ditch on overbends at the time of tie-in as specified in CD.

9.2 **Bends:** Where bends are necessary the pipe shall, at company's discretion, either be bent cold or welding ells installed.

9.21 **Torches:** In no case shall the pipe be heated for bending.

9.22 **Buckled Pipe:** No bend shall be used if the pipe is buckled in making the bend.

9.23 **Miter Bends:** No bends shall be made by means of miter welds unless specifically authorized by company's chief inspector.

9.24 **Vertical Bends:** In traversing washes or canyons, the horizontal run, whether buried or overhead, shall be straight, and the bends shall be well supported in the banks of the wash or canyon.

9.25 **Minimum Radius:** All bends with a greater curvature than 1½ deg. per pipe diameter shall be made with welding ells or portions of welding ells. All bends with a curvature less than this may be cold bends, unless specifically designated otherwise in CD. No bend shall be used if the cross-section of the bend is deformed from circular, so that the difference between maximum and minimum diameters at point of bend exceeds 2½ per cent of the original diameter.

9.3 **Lowering:** Lowering of the pipe into the trench shall be done only at times specified in CD.

10. **Backfilling:**

10.1 **General:** As soon as the pipe is lowered into the ditch, it shall be covered with a layer of earth at least 6 in. thick. Complete backfilling shall follow as closely as practicable. All material removed in ditching shall be backfilled into or over the ditch.

10.2 **Method:** The backfill to a depth of at least 4 in. below the pipe shall be selected material free from rock and other materials that might damage the pipe coating. Where meeting this requirement necessitates hauling in select backfill material, this shall be done at contractor's expense. The backfill around and up to at least 6 in. above the pipe shall be as free of rocks and other debris as practicable and in no case shall rocks be allowed to impinge directly upon the pipe. To prevent the impingement of rocks upon the pipe, a rubber-fabric belt may be pulled along upon the pipe as the backfill material is pushed onto the pipe. Where damage to the coating is found to have occurred during the backfilling operation, the company's inspector may require that the damaged section be uncovered and repaired and this shall be done at contractor's expense. In cultivated fields, rocks shall, in so far as possible, be placed in the middle strata of the backfill above the pipe and covered with not less than 12 in. of rock-free top-soil.

10.3 **Drainage:** The backfill shall be replaced in such a manner that all spoils may be placed over the trench and not interfere with any drain or natural water courses. On steep slopes company may require the installation at intervals along the trench of drain diverters constructed by placing sacks filled with earth around the pipe.

10.4 **Road Crossings:** Where it is necessary to cut the surface portion of a highway, street, road, or driveway, special care shall be taken in tamping backfill to a maximum compression to a point six inches below the road surface. The balance shall be made up of prepared asphalt or cement conforming to the balance of the surface portion of said highway, street, road or driveway as required by the controlling road authorities. No debris or spoils shall be left on any paved portion of any highway, street, road, or driveway.

11. **Completion Tests**

11.1 **"Stand-up" Test:** After the pipe and fittings have been installed and the final tie-ins made, company shall install a recording pressure gauge in the line for a 24-hour test at the required test pressure. If, in the opinion of the company's chief inspector, the test chart shows a pressure drop other than that due to temperature change, a leak or leaks will be indicated. Any leaks, splits, or other failures shall be located and repaired by contractor at contractor's expense and the test repeated.

11.2 **Scraper Test:** Company may require the contractor to test the completed line or any portion by running through it a pipeline scraper or "pig" designed for the size of pipe used. Any obstruction which stops the scraper shall be removed at contractor's expense. Where such repairs have been made, the line shall not be backfilled until inspected and approved by company's chief inspector.

12. **Clean Up**

12.1 **Surplus Material:** All surplus material, equipment, and other property belonging to company shall be returned by contractor to the locations designated in CD.

12.2 **Debris and Refuse:** As soon as the pipe is laid and backfilled, contractor shall clean up the right-of-way. All discarded pipe, lumber, and other debris resulting from operations shall be removed from the right-of-way. All brush, timber, etc. shall be removed and burned or disposed of otherwise. No burning shall be done at places or times such that the burning will endanger adjacent property or be a nuisance to property owners. Contractor shall adhere to all state or local regulations relative to the disposal and burning of rubbish.

12.3 **Land Surface:** Contractor shall leave all work sites in a neat and orderly condition and the ground surface shall be returned to its original condition in so far as practicable. Ruts due to vehicle traffic and the passage of work equipment shall be repaired by contractor. ■

Subsurface analysis starts with the strike of the hammer against a steel plate on the ground. The shock wave travels underground to the geophone and on to the electronic counter. Distance can be measured from the plate to the geophone. Time is measured by the counter.

Seismic analysis helps cut ditching costs

ROCK—where and how tough—has long been a headache for pipeliners. But a new simple method quickly and inexpensively pinpoints location and determines rippability.

Some important questions confront pipeliners when their big ditchers start down the right-of-way: Is there any rock in the path of the wheel? Can the rock be ripped? What equipment will be needed? How should it be used? Proper answers to the questions can mean several days and many dollars gained—sometimes can make the difference between getting or losing a contract, profit or loss on a job.

Caterpillar Tractor Co. developed seismic analysis as a quick, easy and inexpensive method to determine if subsurface material is rippable without moving a tractor and ripper onto the cut. Tractor-ripper try-outs are time-consuming and costly.

First, Caterpillar engineers looked at other methods to see if they could be adapted to this problem. The Los Angeles Rattler Test for hardness—conducted

on a sample of rock—looked good at first. But hardness alone does not determine rippability. Even granite can be ripped economically if it is fractured or weathered. *Consolidation* is the key to rippability. Core drilling only tests spots, not overall conditions—and the rattler test checks only rock samples, not consolidation.

Next, they tried the electrical earth resistivity method. This has been used successfully by the Bureau of Public Roads and state highway engineers. In this method, an electrical voltage is applied across an area to measure the resistance of the earth. This method gives good results in unconsolidated materials, but a typical state highway department believes it takes a trained geologist with a year's experience to accurately interpret the readings obtained.

Something simpler was wanted—something a user could handle with only a few days' training. Seismic analysis offered these features. The refraction seismograph has been used extensively in mining and petroleum work. It is lightweight, sturdy and accurate; it can be operated with a minimum of training. The procedure was available—it was up to Caterpillar to interpret the results in terms of rippability.

Principles behind seismic analysis are simple. Sound or shock waves travel through varying subsurface materials at different speeds and along separate paths. Speed of a seismic wave depends upon the type and density, or consolidation, of the material. Path of the wave varies with speed and the thickness of the layers of the material through which it passes.

A wave source will create numerous waves. At short distances the surface wave will be the first to reach the receiver, or geophone. As the distance from the source to the geophone increases, waves refracted through denser subsurface materials, traveling at a greater speed, will reach the geophone before the surface wave. Only the first wave received is recorded by the electronic time counter.

With this time and distance data, two formulas and a graph provide information on the depth of the layers of different density materials and the speed of the waves. Rippability can be determined by identification of the materials and relating the speeds of the waves to the materials.

Equipment needed for seismic analysis includes a source of a wave, a receiver, an electronic counter and a set of tables.

The sound or shock wave can be produced by several methods. In oil field work, dynamite is usually used. This can give readings down to more than 25,000 ft. Such depth is not needed to check a ditch cut. In addition, even a small blast should not be used in many areas due to proximity of men and machines or populated areas. For the purpose of this study an 8-lb sledge striking a 6-x-6-x-1-in. thick steel plate produces an adequately sharp wave, strong enough to provide readings to depths of 50 ft.

The receiver is a standard geophone—a moving coil in a silicone fluid, resting on a base. A flat base geophone, which sets on top of the ground, is used if the surface is hard. A cone-shaped base can be pressed into the ground for better pickup in loose soils.

An electronic counter determines the time interval between the strike of the hammer and the arrival of the seismic wave at the geophone.

Knowing the time of the wave travel and the distance from the hammer to the geophone, depth and wave velocity can be determined with two formulas. Caterpillar has conducted more than 200 tests in 18 states to establish tables of rippability based on wave velocities for a dozen of the more common materials. Since wave velocities and rippability vary by consolidation, the table can be used to learn if a cer-

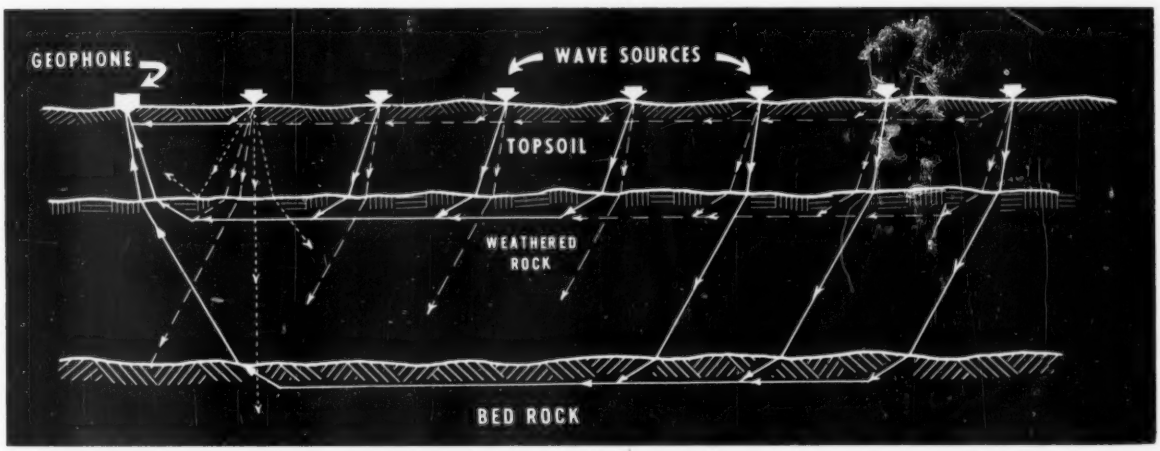


Fig. 1. Operation of the seismic analysis equipment can be seen here. Seismic waves are created at the arrows, starting at a point 5 ft from the geophone and moving out 5 ft at a time to 40 ft. At 5 ft, the wave near the surface is the first to reach the geophone. From 10 to 20 ft, the wave traveling through the denser weathered rock reaches the geophone before the waves traveling through the less dense topsoil or the deeper bed rock. Beyond 20 ft, the waves traveling through the bed rock are the first to reach the geophone. Although these waves travel farther, they move faster.

tain velocity through a certain material indicates it is rippable.

Recently, a test was run on a section of the 24-in. Michigan-Wisconsin pipeline being looped near Manhattan, Kan. Three areas were checked where possibilities of rock were indicated by the terrain.

Two men easily carried in their 40 lb of equipment. Inside a small metal case, about the size of an overnight case, was the electronic counter, ready to operate on self-contained batteries. A geophone was set on the ground and its wire plugged into a receptacle in the face of the counter. One end of a 100-ft wire was plugged into a second receptacle and the other end connected to a spring contact switch on an 8-lb sledge. A small steel plate was set on the ground 5 ft from the geophone.

One man took readings from the counter while the second struck the steel plate with the sledge. When the sledge struck the plate, the switch closed, starting the counter. Lights flashed across the counter, marking the milli-seconds fleeting by until the seismic wave reached the geophone, stopping the counter. Steady lights indicated the elapsed time. This time was noted on a data sheet opposite the distance from plate to geophone while the hammer man moved the plate to a new location, in line with the first but 10 ft from the geophone. This process was repeated every 5 ft until the plate was 40 ft from the geophone (Fig. 1).

In less than 10 minutes the test was completed and computations were made. Velocity of the seismic waves were found by the formula

$$V = \frac{D}{T}$$

where D is the distance from the plate to the geophone and T is the time lapse. This was plotted on a graph, with distance in feet plotted along the bottom and time in milliseconds plotted up the side. Points fall in line for each type of material since velocities are the same for a similar consolidation. Straight lines drawn through adjacent points showed three types of materials. Intersection of the lines indicated the changes in consolidation.

Next, the depth at which these changes occurred was computed from the formula:

$$D = \frac{Xc}{2} \frac{V_2 - V_1}{V_2 + V_1}$$

where D is depth; Xc is the distance along the bottom of the graph from zero to the intersection points of the lines; V_1 is the velocity of the seismic wave in the upper layer; and V_2 is the velocity of the wave in the next lower layer. Depths of successive layers are determined in a similar fashion (Fig. 2).

Results indicated that top soil extended 3.5 ft deep. Weathered rock lay below this material, resting on bed rock, 10.7 ft below the surface. Velocity of the seismic wave through the rock indicated it was rippable with a Caterpillar D9 Tractor equipped with a 7-foot Kelly Ripper. In this case, the type of rock was determined by outcroppings. It can also be determined by core drillings or local knowledge. With this information, the pipeliner would be able to better schedule his equipment needs.

Thus seismic analysis can help pipeliners determine when they can rip and when they must resort to the more expensive blasting. It will enable them to use their equipment more effectively. They can expect greater profits through fast, inexpensive subsurface analysis, more productive equipment and job organization, and lower costs. ■

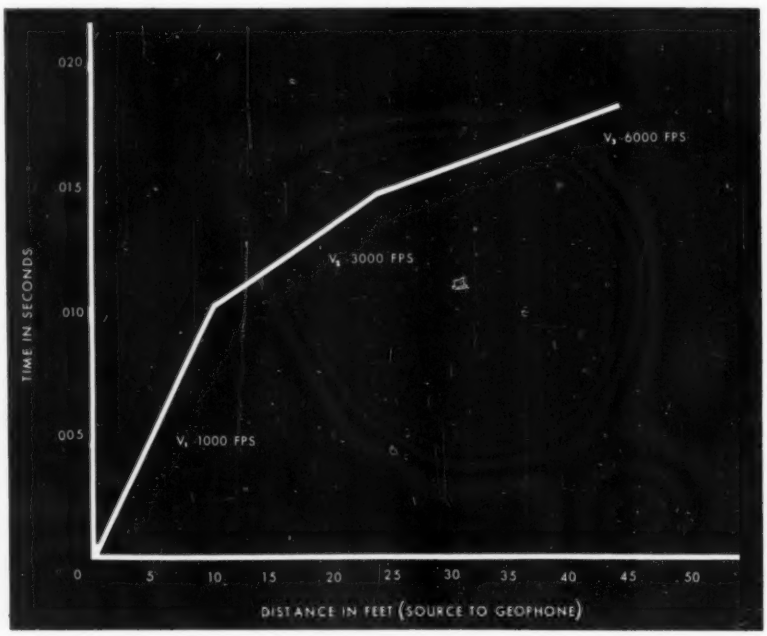
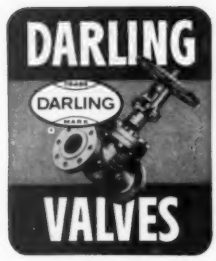


Fig. 2. Time and distance are plotted on a graph, with distance in units of feet along the bottom and time in units of milliseconds along the side. Straight lines are drawn through adjacent points. Xc (see formula in story) is the distance from zero feet to the point of intersection of the lines. Each material will have its own slope.



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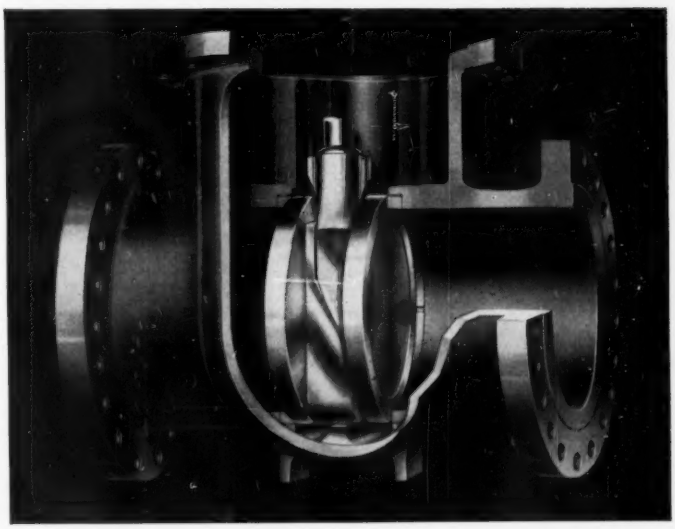

Above top: Darling 30" motor-operated gate valve powered by gas from line pressure.

Cutaway, below, shows simplicity of Darling's unique fully revolving double disc parallel seat gate valve principle—just four simple working parts—two plain interchangeable no-pocket discs and two husky wedges.

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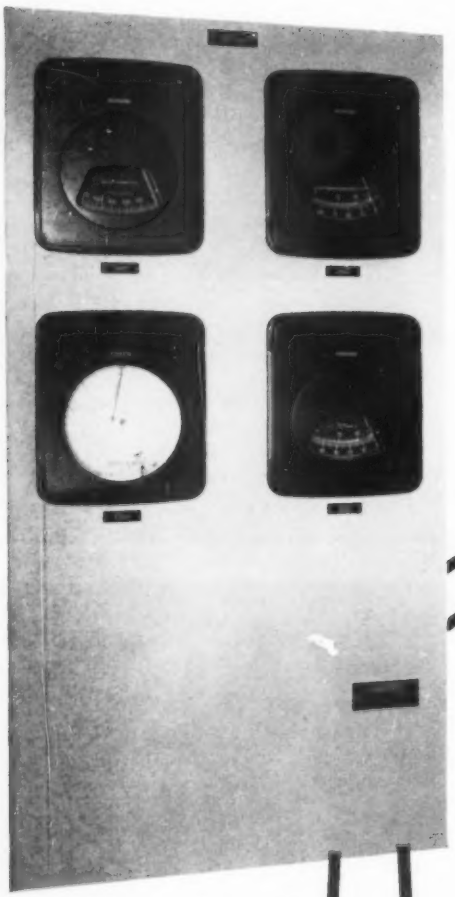

Typical Foxboro Gas Flow Computer Differential and static pressure instruments (right side of panel) convert measurements to electrical inputs for the Dynalog Computer-Telemeter (lower left). Instrument at (upper left) telemeters down-stream gas pressure.

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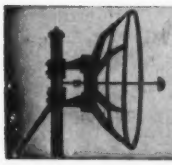
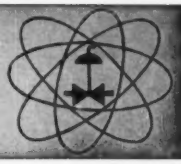


Communications and Automation



Edited by FRANK CHAPMAN

Wanted: Inventions

By F. VINTON LONG

"There is one thing stronger than all the Armies in the world, and that is an idea whose time has come."

——*Victor Hugo*

THERE is an agency called the National Inventors Council in Washington, whose purpose is to reduce the requirements of the country and particularly from the Armed Forces into written form and pass them on to the public in general, including that peculiar breed of amateur inventors. It is quite a serious business and for defense purposes might some day keep you and me alive if somebody comes through with something that is very good.

The council will carefully examine the invention and pass it on to the appropriate agency, such as the Army, the Navy, or the Aeronautics Research Board and you will receive a fairly prompt reply concerning your ideas. I have personally sent in several, including a method of airplane landings on seagoing carriers, a helicopter design which I am afraid would make the poor thing fly only backwards, and a one-piece airplane wing which would be expendable in the case of a crack-up and would not spew flame and fuel all over the pilot and the passengers.

All of these were duds.

But the council and agencies concerned did come through with very extensive reports on just why these things would not work, and it was worthwhile and it will still be worthwhile to know that at least one made an effort to bring out something that is useful.

That is the trouble with most of the people who do not invent anything. They feel that if they happen to think of something, that undoubtedly some other character has thought of it first many, many years ago and often times this is the case, usually about 500 years ago. But once in a while that is not so, and you certainly cannot develop an invention if you don't try and that, of course, is the mark of the true inventor.

He will try.

He will try, even though there is little chance that someone has not first discovered the device, and he will be energetic enough to pursue the development, at least on a limited scale, despite the fact that most of his friends probably think that he has a battery wire dragging or has a hole in his head.

The writer has brought out a few, some good and some bad, and has several patents pending. However, some of the things which I would like most to invent are those particularly useful in the oil and gas industry and in pipelines. Somehow the harder I try to think of something in these fields the more elusive the target becomes.

In an effort to stir up interest among all of you readers of this column, I would like to put out a call for inventions or notice to inventors, somewhat like the program carried on by the National Inventors Council, but in this case, your thoughts and ideas could be transmitted to GAS Magazine and Fred Ebdon will try to see that they hit a proper slot.

This also is a call to the many manufacturers around who undoubtedly have the engineering brains to dream up almost anything we want but, possibly because of the lack of a secure market, have not put too much effort into this work; or something real "hot" might come from a microwave maintenance man or a meter man or the man that drives that "cat" out on a spread.

Good ideas are not limited to the privileged few.

They come to all of us, but what we have to do is to do something about it. The first way to do something about it is to get it into print and to show it to somebody else, because an invention contained within yourself is no darn good to anyone.

Here are some of the things which I believe the oil and gas industry and particularly the pipeline industry require, and there must be someone reading this that has an idea for a good solution.

If the solution is good you can either try to patent it, or you can pass it on to your friend, or you can build it yourself and sell the gadget. Anyway, the development of this idea will not hurt you; it may do you some good and at least will give you something interesting to do.

The first requirements for communications on a pipeline system, in my estimation, is my black box concept of a microwave transmitter/receiver, which of course now sounds like an old broken record to everyone who has heard me preach it.

I will try to explain this. In the first place, the microwave systems now commercially available are not designed at all for pipeline use. They are primarily set up for heavy density traffic, such as used by the common carrier telephone companies and in the few instances where a pipeline might have a multiplicity of telecontrol functions, or executive traffic where a large number of channels are required and thereby the high expenditure is justified. For most of the pipeline requirements, just one or two channels will suffice and

these one or two channels, especially one channel, could be made simple, so it could be installed at just a fraction of the present microwave mileage cost.

It should be a completely transistorized black box which sits on a fence post and is battery powered with main operating power replacement coming from the sun, the wind, or direct fuel to electrical energy devices.

That means that you can set these little repeaters all over the place and the cost per mile for a very reliable channel would be very, very low. The thing would not have to operate at 6000 Mc; it could start out at 960 Mc and then as transistors became available in the higher frequencies, you can go on up. But we need something right now.

The second thing that we need is a good dependable source of power, which in the case of the transmitter and receiver in the little box might not be much of a problem but it certainly is a problem now in the larger microwave units. We need something that will keep running forever. It has an instantaneous cutover feature if two of them are used, or if standby power is used as an emergency source.

We need a little black box one-way signaling device to transmit telemetered information, say from small gathering systems or from wells into a central location for dispatching purposes. These should also be fence post mounted.

We need very simple telemetering devices which would collect this data.

Going the other way, we need very, very accurate transducers to measure such things as pressure and flow and bring out the information in such a method that it can be easily transmitted to a control point.

I am talking now about 1 lb in 1000 instead of 20 lb in 1000.

We need adequate, cheap and simple warning devices to tell us when a gas regulator might freeze up or a pipeline springs a leak. I believe that part of this has been brought out in the Motrel, manufactured in Louisiana, and the device developed by Mr. Wooster of Michigan - Wisconsin Pipe Line Co., which was described in a previous column. But there may be a better way to do this.

A method different from the use of co-axial lines and microwave and telephone cable for communications. This will include the use of the pipe itself as a transmittal medium of radio signals or audio signals, possibly using the pipe as a transmitter of sonic audio frequency telemetered signals. This is entirely feasible now but in short distances.

Maybe electromagnetic wave communication using an extremely low frequency with the use of buried wire antennas. Even if considerable power might be required, possibly the energy could be directed in a desired direction without excessive loss.

We need ways, simple and reliable methods of tele-control of unattended compressor and pump stations.

We need a method to somehow reduce the price of co-axial cable; that is, cable which is buried in the pipe ditch, to give us reliable low maintenance communication links between our compressor and pump stations. This is, of course, available now, as mentioned in a previous column entitled "A New Method of Pipeline Communications," which describes a plan to use it as a low frequency cable for communication links without the use of intermediate repeaters.

But it can be improved on.

There is an electronic firm in the East which is now working on a very small transistorized one-way repeater, which might work in the audio or the lower video range, and these little gimmicks could be buried right with the underground cable and should last indefinitely.

Is there a better way to do this?

We need to develop a better passive repeater to put on a mountain top and do away with the necessity of a cumbersome microwave repeater station. There must be some way to do this.

A method should be worked out whereby all communications equipment is plug-in and there is some sort of automatic gimmick like a grasshopper fuse which will tell the maintenance man immediately just what is wrong and he can plug in a new unit.

There should be developed a new type of gas dispatch board which, with a computer, will automatically control the entire line and at the same time provide sufficient information for the dispatcher to do the thing which he is there for and that is to improvise and think.

Something should be devised to pick up the ball in a communication system which opens up and carries the communications in some emergency matter, possibly on a VHF emergency channel, between the two last operative links of the system.

The military would like very much to have this same thing to operate on land lines, so that if they lose a line through shell fire or something, in some method they can still maintain communications. This is one of the inventions listed by the National Inventors Council for the military.

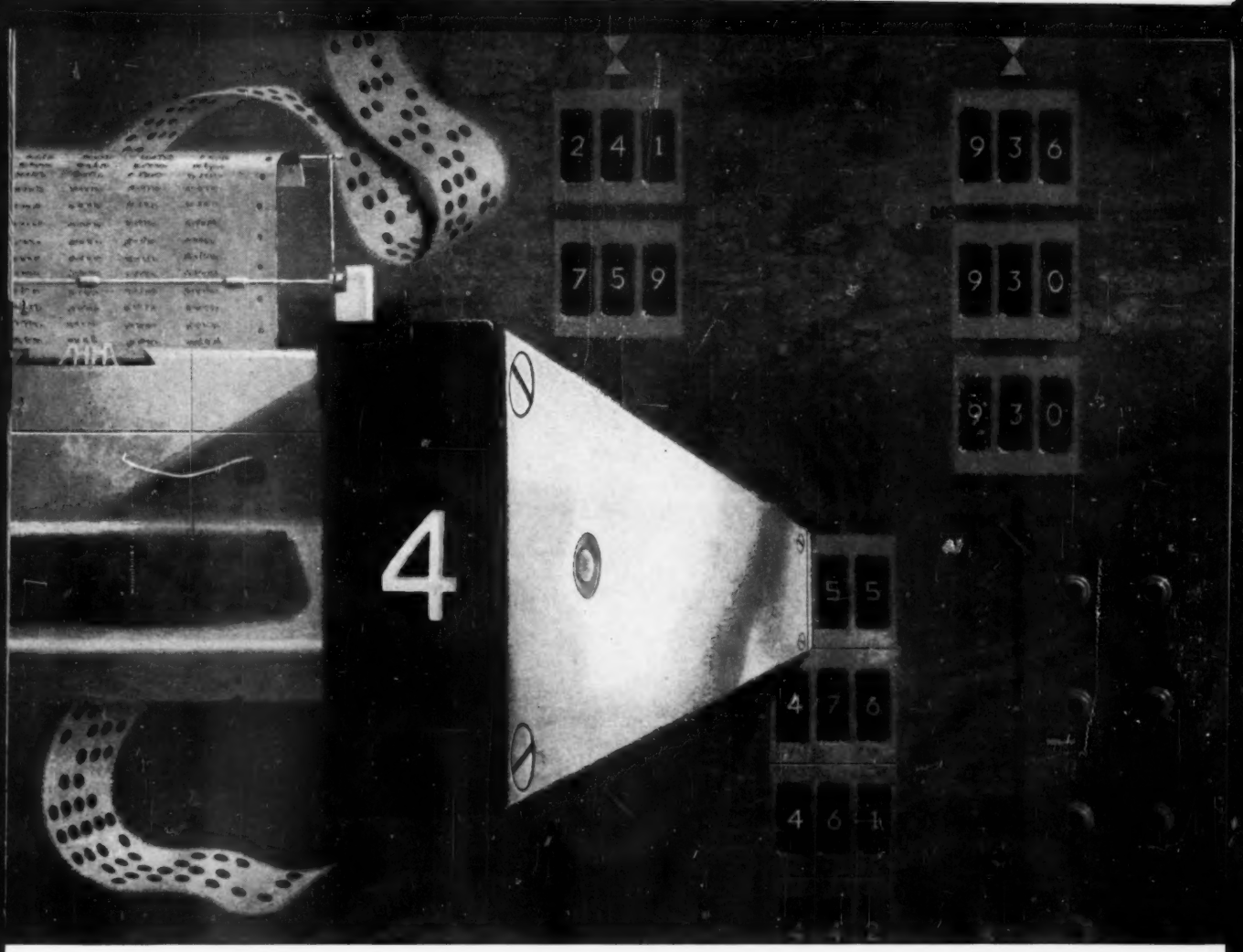
Also, in case any of you are interested, the military would like to have an acoustic trackless transducer, a sharply undirectional device of small size compared to wave length for sound detection of signals as low as five cycles per second.

They would also like to have an electromagnetic radiation receiver, which is a device for receiving electromagnetic radiation in the 9 to 14 micron region which will have a response time of microseconds and will operate at normal temperatures.

Also, a microwave super gain antenna that should operate in the bands between 1000 and 30,000 Mc. They also require a pressure sensing device, which is a small sized pressure senser not dependant on bellows, diaphragms, or bourdon tubes, to provide an accurate indication of pressure in fluid lines and combustion areas. I would say that we in the pipeline industry could use the same thing.

There are scads of things which need to be invented and there are probably scads of things which people know should be invented but they haven't bothered to mention it to anyone.

Possibly this column might serve as the catalyst to stir up the thoughts of those who require an invention and those who have an invention but just don't know what to do with it. ■



NEW CONTROL CONCEPT
can cut your pipeline costs

Did you ever try to solve a jigsaw puzzle without first looking at the total picture the puzzle makes? Pretty difficult—maybe even impossible. Best way, easiest way is to look at the big picture first, then see where the individual pieces fit.

It's the same with pipeline control.

First, look at your total system problem. Then, determine what sort of control system is required to safely, reliably and economically meet tomorrow's need as well as today's. That is Union Switch & Signal's approach to pipeline control.

Any part of a pipeline system. Union Switch & Signal can incorporate in a centralized control system any or all of the following functions: supervisory or remote control of satellite stations . . . telemetering of flow data from field back to your central dispatching office . . . automatic sequencing or control of equipment in the field . . . instrumentation . . . data handling and display . . . computing equipment . . . automatic integration of field data into your accounting operations . . . communications. Union Centralized Transport Control can be adapted to *any* problem from remote control of a single-unit booster station for gas or oil to automatic centralized control of an entire system from wellhead to ultimate consumer.

Error-free. Whatever the job assigned to it, Union Centralized Control operates completely free from error because it reduces to coded digital form all information and instructions transmitted to or from your central control office. As a result, you can transmit far more precise data than ever before; you can use the least expensive available communications service; and you never need to worry about lightning, noise or other interference causing a wrong or dangerous operation—this coded system automatically checks itself and responds *only* to correct and logical signals. It helps make your pipeline safer. It provides error-free *security* as well as reliability.

Lower operating cost. Most important, Union Centralized Transport Control cuts your operating costs, cuts the cost of future expansion, sometimes even cuts present installation cost of pumping stations.

Write for Bulletins PD 2006, PD 2007 and 1052

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FPC Approves Midwestern's Import of Canadian Gas

The Federal Power Commission has finally approved Midwestern Gas Transmission's application to import 204 MMcfd of natural gas from Canada. The Houston-based subsidiary of TGT received its authorization on the eve of expiration of its gas purchase contract with Trans-Canada Pipe Lines Limited. The commission action moves additional gas supplies from Canada a big step nearer.

Midwestern will build an over $52-million project from Emerson, Manitoba — where Trans-Canada will deliver — to Marshfield, Wis. There, it will connect with a $24-million Michigan Wisconsin Pipe Line Co. project, approved by FPC at the same time. Mish-Wish will handle 158 MMcfd of the Canadian gas, purchased from Midwestern. Ultimate consumption of the imported energy will be in communities in North Dakota, Minnesota, Michigan, and Wisconsin.

Several conditions were attached to the authorization. Midwestern will have to wait for Trans-Canada to obtain permission from Alberta authorities and Canada's five-man National Energy Board before the gas can be exported from that country. Activation of this board in November increased the possibility that this body will act on a license for Trans-Canada to sell gas to Midwestern by the first of the year. The Canadian cabinet will then have to finalize the export by approval of the Energy Board's action. It appears that FPC feels these approvals, along with permission for Trans-Canada to build from its mainline to Emerson, will be readily granted.

The FPC said that since Midwestern will probably not start construction for about six months, it did "not think it wise" to try to fix a rate of return right now. They will have MGT file rates and supporting data 60 days prior to starting service.

And FPC conditioned that Midwestern cannot pay dividends on common stock until long-term debt is reduced to 75 per cent of capitalization.

No direct price conditions were imposed, but a rate "tilt" and a differential between mainline and lateral sales, among other things, were questioned. Commission will look at them again after a year's operating experience has been gained.

The approval for Midwestern is based, price-wise, on their contract with Trans-Canada. It appears that FPC approves this price. If the Canadian National Energy Board should change this price, some experts on commission matters feel FPC could take back its authorization and go into the matter again. There has been no hint of such action by the Canadian board.

Of the 204 MMcfd Midwestern is authorized, 201 MMcfd will be sold for resale. Compressors will use the rest. As mentioned, 158 MMcf will go to Michigan Wisconsin Pipe Line Co., the remainder of the resale gas will go to Northern States Power Co., Montana-Dakota Utilities, United Petroleum Gas Co. and nine Minnesota communities.

Michigan Wisconsin will deliver to: Allerton (Iowa) Gas Co.; Natural Gas Distributors, Inc., Sparta, Wis.; Seymour (Iowa) Gas Co.; Central Missouri Gas Co. (Jefferson City); Illinois Power Co.; Iowa Southern Utilities Co. (Centerville); and New London (Iowa) Gas Co.

The "Midwestern Case" has been long pending. Applications by that company and several others with plans for serving the north-central and midwestern states were denied by FPC more than a year ago. However, at that time FPC said it favored further importation of gas from Canada, and made some suggestions for the project. Then, Midwestern divided its system into two parts and filed separate proposals for each.

One part, from Portland, Tenn. to near Chicago, has been approved, constructed, and went in service during October of this year. The Canadian segment now seems to have a green light for construction.

In Canada, the news was hailed as possibly breaking the log jam of export projects that will fully develop Canada's oil and gas industry.

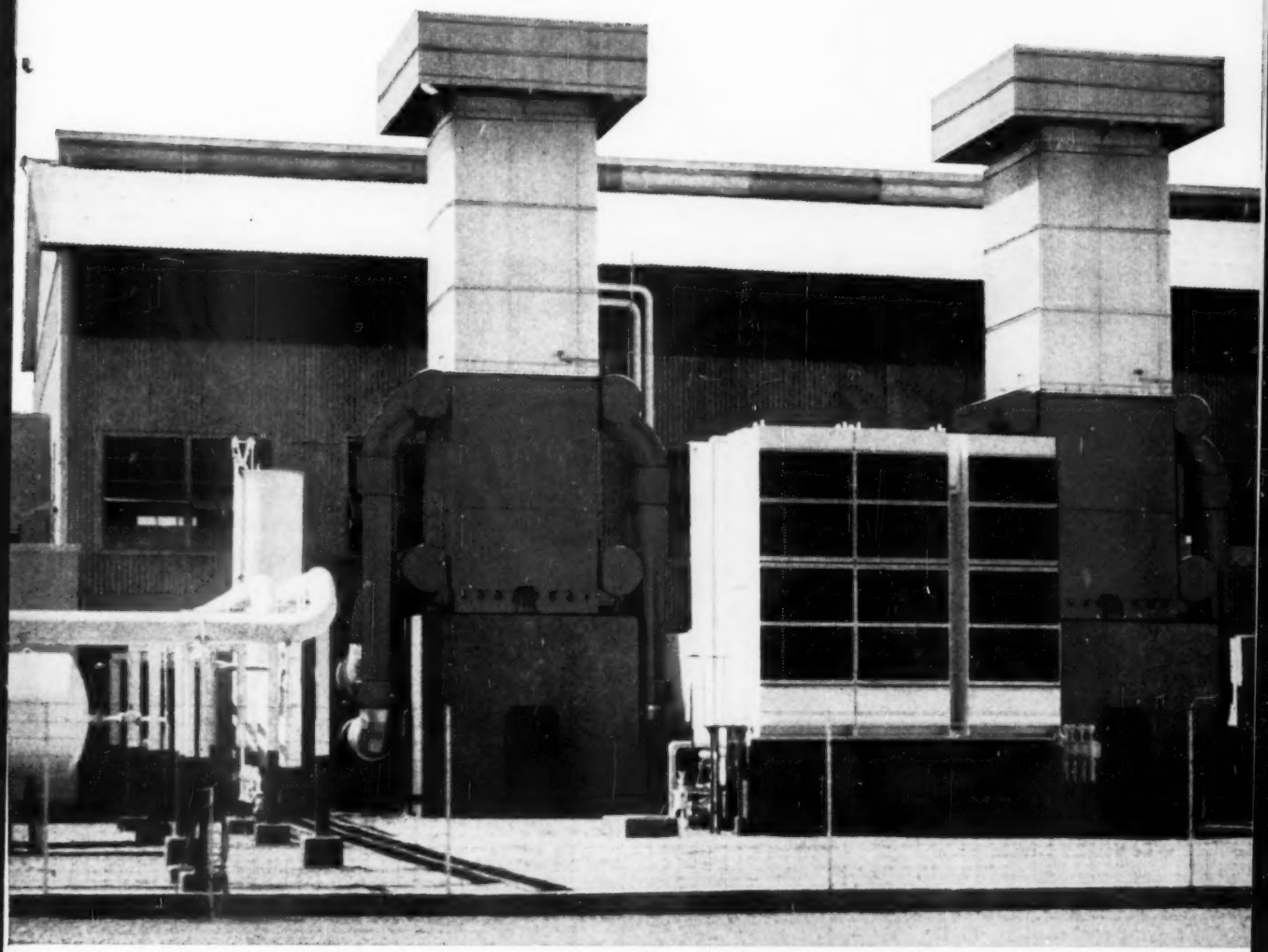
James W. Kerr, president of Trans-Canada Pipe Lines Limited, said: "We are extremely gratified by the decision of the Federal Power Commission approving the importing of Canadian natural gas into the United States at Emerson, Manitoba."

More News on page 138

John Merriam (left), president of Northern Natural, and Marvin Chandler (center), president of Northern Illinois, officially turn on new gas supply to benefit NI-Gas customers. Looking on is George Perrine, chairman of the Illinois Commerce Commission. Ceremonies at the tap station marked completion of Ni-Gas' 140 mile line from East Dubuque to Des Plaines. The Illinois company is receiving a new 50 MMcfd supply from Northern Natural.

Consumers Gas Co. has completed the 13-mile transmission line to bring natural gas to Canada's Camp Borden. Recent ceremony of the Consumers' metering station marked completion of the line and beginning of service. At the valve-turning, Brigadier R. L. Purves, camp commander, said gas is expected to save the establishment about $250,000 annually.

IT TAKES LESS THAN 500 MANHOURS TO INSTALL A **FIN-PAK®**



Dual Fin-Pak heat exchangers at El Paso Natural Gas Company's compressor station at Caprock, New Mexico. The two 5,000-hp gas turbines at the Caprock station pump an average of 12,000 CFM, 24 hours a day.

Fin-Pak's prefabricated design, light weight and compactness cut installation time and labor costs to a minimum. On a typical 5,000-hp gas turbine cycle, for example, fewer than 500 manhours are required for *complete* installation of a Fin-Pak.

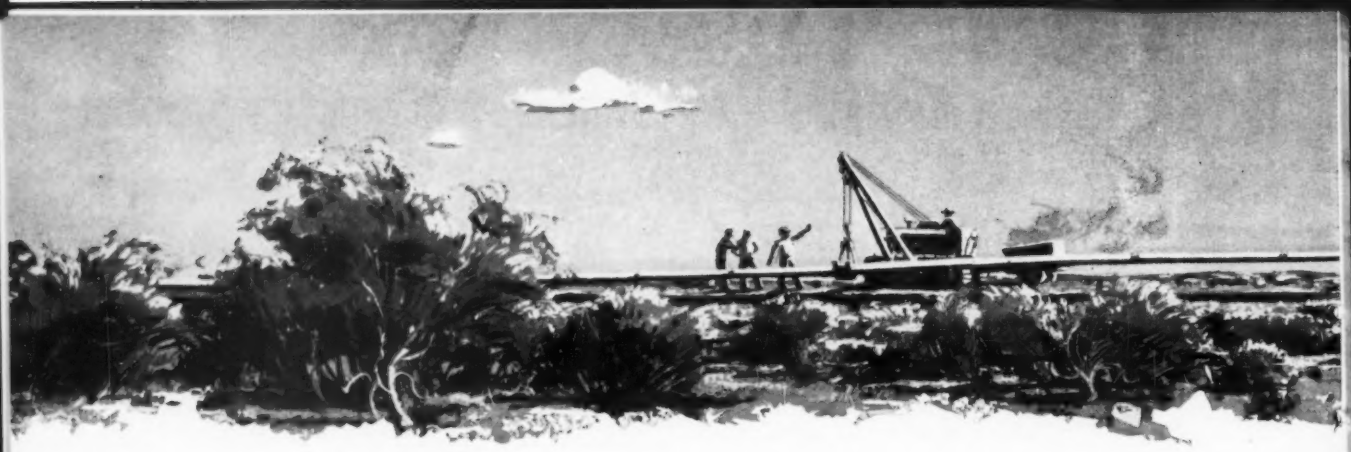
And installation economies are just the beginning. In operation, a Fin-Pak can cut your fuel bill by as much as 32%*, because it recovers up to 80% of the heat from the turbine exhaust and returns it to the combustion air.

And maintenance is a cinch with the Fin-Pak. It has short, straight-through passages. Occasional cleaning with compressed air is *all* the maintenance a Fin-Pak needs. **One last thought:** a gas turbine station requires about 80% *less* plant maintenance personnel than a station of equal capacity operating diesels, steam turbines or gas engines. For complete details, call or write Air Preheater.

*A Fin-Pak with a designed efficiency of 75% in a gas turbine cycle at 6 to 1 pressure ratio and a turbine inlet temperature of 1500°F.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



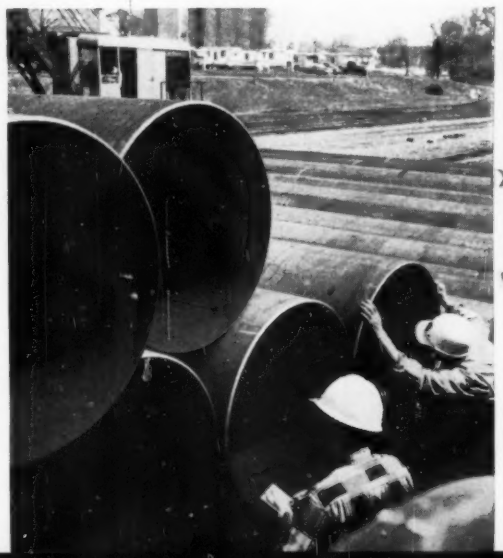
Steel pipe crosses the

Into the Bush Country sixty miles northwest of Corpus Christi, Houston Pipe Line Company trucked ton after ton of Bethlehem Steel line pipe. The pipe was true to round and bevel, so there were no delays as it was welded into a continuous length and buried in the sun-baked Texas soil. Only a few days were required to build the gas-tight pipeline now stretching from the town of George West to a tie-in line 25 miles west of Beeville.

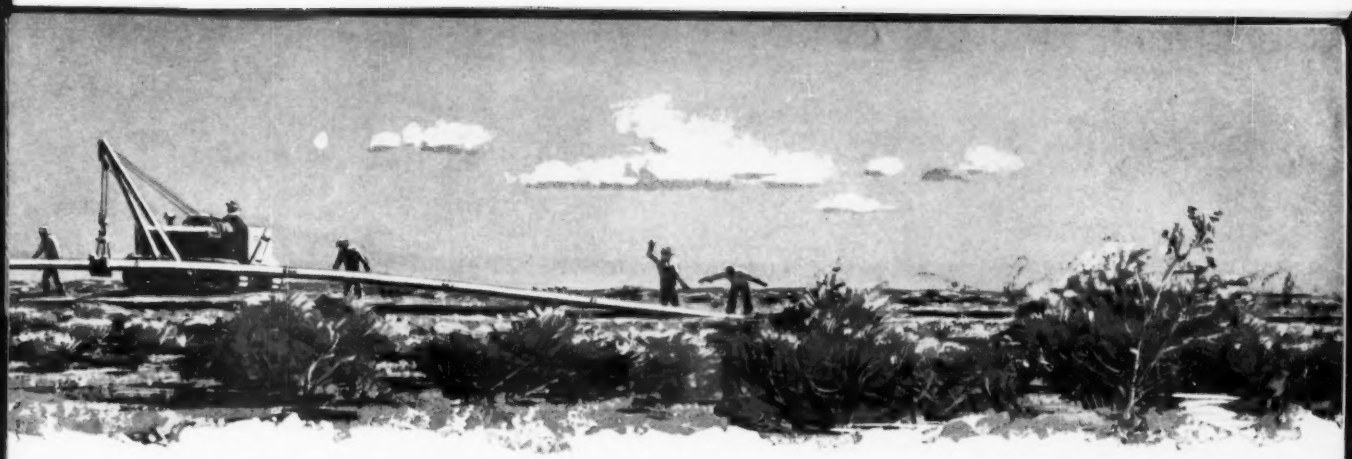
Sheppard Geiger Construction Company, Corpus Christi, tested out the line at 1,050 psi on the first try, and Houston Pipe Line Company approved it for service, reinforcing major gas supplies for Houston Natural Gas System.

BETHLEHEM BUTTWELD LINE PIPE is also popular in the wide open Southwest. Here, Highlonesome Pipeline Company, Abilene, Texas, installs 3-in. Beth-Co-Weld plain end pipe 25 miles Northeast of Artesia, N. M. Engineered and designed by the Supply Division of Bethlehem Steel Company, the surface line will be a gathering system for Utex Exploration Company and Charles A. Steen of Moab, Utah.

Bethlehem continuous buttweld line pipe, manufactured in sizes from ½ in. to 4 in. (nom.) and in various lengths, can be counted on to meet required specifications.



BIG—BUT NOT THE BIGGEST. This is 36-in. OD electric fusion-weld line pipe, made for a number of Texas-based pipeline companies at our Steelton, Pa., pipe shop. Bethlehem supplies line pipe up to 42-in. OD with walls to ¾ in.



land of sage and sunshine

Bethlehem electric resistance-weld line pipe is a favorite down Texas way. We produce it to required specifications in sizes from 5-in. (nom.) to 16-in. OD, and in lengths to 60 ft. The steel pipe we furnished for this line was 12¾-in. OD x .250-in. wall, API 5L, Grade X-42.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

pipeline news • *Cont'd.*

from page 134

Transco's 155 MMcf plan gets go-ahead

Transcontinental Gas Pipe Line's $53.4 million plan to increase its system capacity has FPC's blessing (Docket G-16603 et al). Involved is an increase of 155.1 MMcfd.

Firm deliveries to 44 existing resale customers will rise by 138.5 MMcfd. A 9 MMcfd increase in Transco's existing firm transport service for Sun Oil Co. will bring that operation up to 29 MMcfd. Transco also was told to supply 7.4 MMcfd to Palmerton Gas Co., Lehighton, Pa.

Approved were only those facilities that Transco proposed under its so-called "1959 construction." The "1960 construction" was denied because it involves facilities in the X-20 transportation service for Consolidated Edison Co. of New York. This service was denied by FPC last January. The courts are studying an appeal of that decision.

Seven applications by independent producers to sell gas to Transco also were okayed. Some interveners wanted price conditions imposed, but the applications were granted without any conditions limiting initial price on the southern Louisiana and offshore Louisiana sales.

Transco's 1959 construction consists of 129 miles of mainline loops in Texas, Louisiana, Alabama, Georgia, North Carolina, Virginia, Pennsylvania and New Jersey, and 53 miles of purchase laterals. Also, compressor additions of 59,280 hp. Unauthorized facilities include 123 miles of line and 19,500 hp in compression.

Gas will come from Cooke field in LaSalle county, Texas; from Raceland field in LaFourche parish, La.; and offshore Terrebonne Parish, La., in the Ship Shoal area. The presiding examiner pointed out that neither FPC staff nor any party to the proceedings raised any issue regarding initial price of the Texas gas—13.5 cents per Mcf. However, three Transco customers and the New York PSC questioned the Louisiana gas price. Raceland gas is going for 21.5 cents, plus tax reimbursements; offshore gas is 22 cents with tax reimbursement provisions.

Transco's gas supply was shown to have a full deliverability life of only 11 years—one year less than the 12 which FPC indicates it deems a minimal requirement. The examiner conditioned his ruling to require Transco to show that it has improved its gas supply situation before filing any future certificate applications.

Alberta Gas pessimistic over gas line prospects

Export of gas may be delayed by tight money and a steel shortage, according to A. G. Bailey, president of Alberta Gas Trunk Line Co., Calgary.

The delay would be caused by failure to complete a $97 million gathering system in the Alberta foothills. Gas delivered would be made by the line to the British Columbia border. From there, it would move into the U. S. for distribution in the Pacific Northwest and California.

Bailey believes it is possible that the line may not be completed until 1961.

If permits aren't issued soon by Canada's newly formed national energy board and the FPC, there will be difficulty in financing the project.

Peoples passes first step

Peoples Gas Light & Coke Co. has hurdled the first step in its plan to reorganize Texas Illinois Natural Gas Pipeline Co. Illinois' Commerce Commission accepted the plan, subject to certain conditions.

Following this, Texas Illinois and Peoples Gulf Coast Natural Gas Pipeline Co. filed a joint petition with the FPC seeking an okay for certain transactions needed to consummate the plan. Peoples Gulf is a new Peoples Gas subsidiary.

ALG line in operation

Arkansas Louisiana Gas Co. has completed its 95-mile line from gas fields in the upper Arkansas River valley.

Described as "a major link" in ALG's three-station system, the line will bring an added 30 MMcfd into the company's system.

The line starts in the Aetna gas field and extends southeast, connecting with ALG's mainline at Perla junction, near Malvern. The line eventually will increase the company's maximum delivery capacity from western Arkansas to 240 MMcfd.

CIG's status studied by state's high court

Colorado's supreme court is studying a lower court ruling that Colorado Interstate Gas Co. rates cannot be regulated by the state.

The appeal was lodged by the Colorado PUC and three of CIG's biggest customers — the city of Colorado Springs, Public Service Co. of Colorado, and Colorado Fuel & Iron Corp.

Last summer, a district judge overruled a PUC finding that Interstate was subject to state rate regulation on its direct sales of gas. Earlier the commission had ordered the pipeline company to list its rates and submit itself to state regulation.

FPC still rules in favor of Blue Ridge

An FPC presiding examiner has again ruled in favor of Blue Ridge Gas Co. after a first order had been remanded by the U. S. Court of Appeals. The early decision was remanded to FPC because the commission had not let a group of petroleum jobbers intervene. At that time, FPC okayed Blue Ridge's plan seeking a supply of natural gas for service in the Harrisonburg, Va., area.

The new ruling (Docket G-14442) directs Atlantic Seaboard Corp. to deliver up to 229.5 MMcf annually to Blue Ridge. Peak day deliveries are not to exceed 2 MMcf.

In August 1958 FPC adopted a presiding examiner's decision directing the same service. Earlier, FPC denied the intervention move by the jobbers. They appealed the commission's action. Last March, the court set aside both FPC orders, and remanded the proceedings to the commission, with directions to let the jobbers intervene.

Presiding Examiner Purdue now holds that there is a "public desire and need" for the proposed service. He concluded that "there is a strong possibility" of the project being an economic success, after finding that Seaboard has gas available and that the estimate of gas sales and revenues at the rates proposed was warranted.

"Granting that it is in the public interest for the fuel oil business in Rockingham county to prosper," he said, "it is not in the public interest for such business to prosper at the expense of the people . . . being deprived of natural gas service."

Many new techniques and methods of telemetering are available today as a result of rapid advances in the science of data processing and transmission. Today, more than ever, selection of the telemetering system best suited to a particular application requires careful study of many alternatives to insure maximum effectiveness at minimum cost.

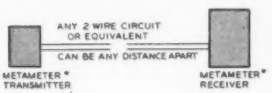
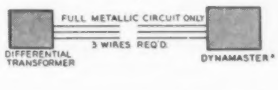
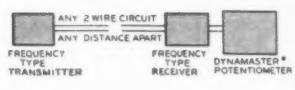
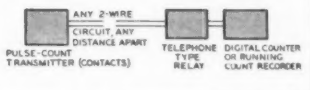
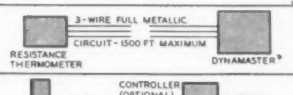
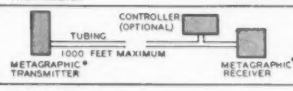
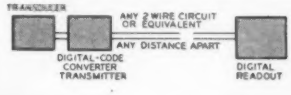
The Bristol Company offers *all* the major types of industrial telemetering systems, as outlined in the table herewith. For some applications, of course, certain features of one system may be combined with another, allowing great flexibility in tailoring a system to your application.

The complete line of Bristol industrial telemetering instruments embodies over 45 years' experience in this field. Bristol engineers are always ready to recommend telemetering instruments to solve your particular problems or to work closely with your own engineers in the design of a complete telemetering system to your requirements.

For further information, write: The Bristol Company, 119 Bristol Road, Waterbury 20, Connecticut.

TIPS ON INDUSTRIAL TELEMETERING

for pipe lines, utilities, and process industries

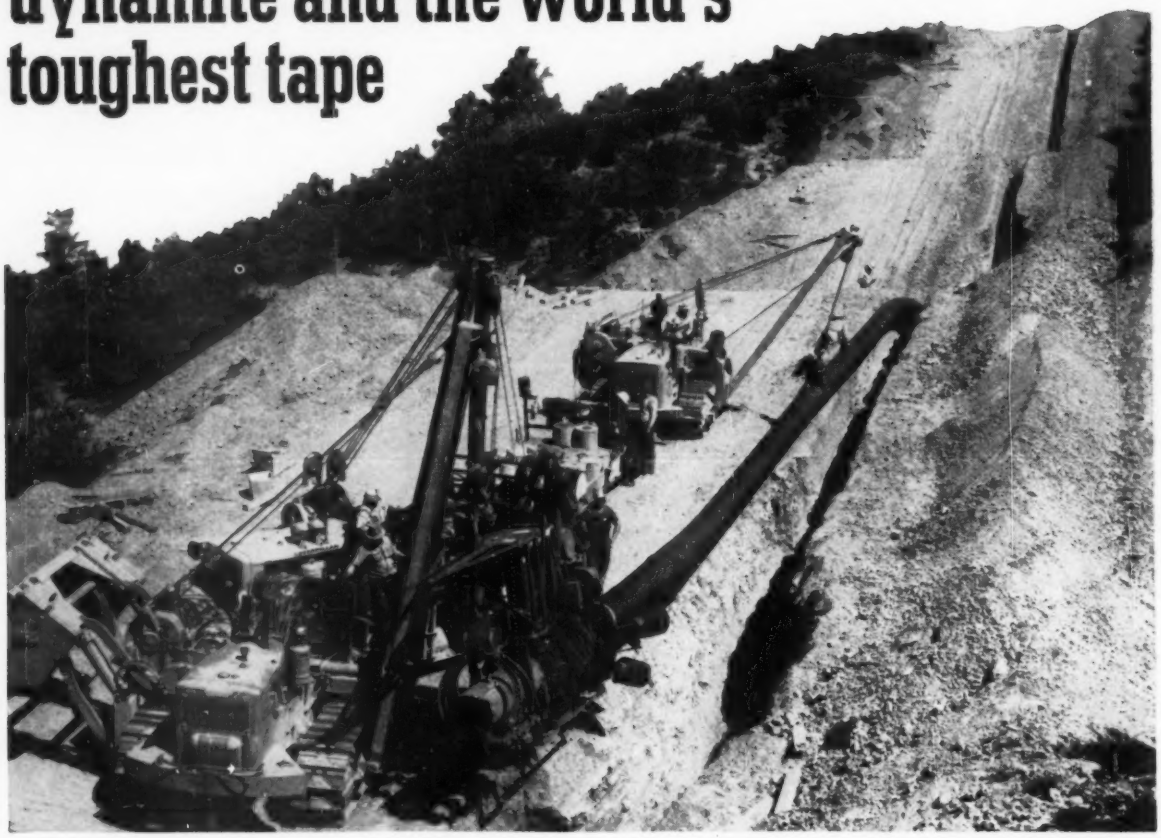
TYPE	OFFERED BY BRISTOL	SIMPLIFIED BLOCK DIAGRAM	ADVANTAGES AND LIMITATIONS	MAJOR USES
IMPULSE DURATION	Metameter*		Simple electro-mechanical device. Will transmit over wire circuit, carrier or microwave links. Offered in 60, 15, 5 or 2 second impulse cycles.	For analog transmission of all measurands.
VOLTAGE	Thermoverters* & Dynamaster.* D-C Transmission		Instantaneous transmission. Limited to full metallic circuits of 2000 ohms (2 wires) free of parisitic currents.	For analog transmission of electrical quantities.
	Differential Transformer Transmitter & Dynamaster. A-C Transmission		Instantaneous transmission. Limited to full metallic circuits. (3 wire.) Can operate into electronic control directly.	For analog transmission of mechanical measurands.
FREQUENCY	Frequency Type Transmitter & Receiver with or without Audio Tone. (RFL) Model with Dynamaster End Device		Practically continuous. For millivolt inputs or measurand to millivolt pick-ups. Will operate over wire circuits, carrier or microwave radio links.	Primarily for transmission of electrical measurands but may be adapted to non-electrical quantities where high speed transmission desired.
PULSE COUNT	Transmitter — Contact Making Device. Receiver — Relay Operated Magnetic Counter or Running Count Recorder	 ANY 2-WIRE CIRCUIT, ANY DISTANCE APART PULSE-COUNT TRANSMITTER (CONTACTS) TELEPHONE TYPE RELAY DIGITAL COUNTER OR RUNNING COUNT RECORDER	Simple. Will transmit over wire circuit, carrier or microwave link.	Primarily for total flow transmission. Not used for instantaneous flow.
POSITION	Dynamaster Resistance Thermometer System		Instantaneous Transmission. Requires 3 wire metallic circuit not exceeding 1500 feet.	Temperature measurements.
PNEUMATIC	Metagraphic System. Metavane* System		Limited to 1000 feet of ⅛" tubing. Can operate into pneumatic control directly.	For non-electrical quantities where pneumatic transmission desired.
DIGITAL	Bristol Servo Transducer with Westinghouse, G. E., or Union Switch & Signal Pulse Code System		For transmission over wire circuits, carrier or microwave.	For digital transmission of all measurands, especially where pulse code supervisory control is available. Direct print-out of readings.

T.M. Reg. U.S. Pat. Off. **Write for technical information**

BRISTOL TRAIL-BLAZERS IN PROCESS AUTOMATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Jobs this rough need mountain climbers, dynamite and the world's toughest tape



New Mandalay line protected by Polyken Extra-Strength #960

Putting in Richfield Oil's Mandalay Line was as mean a job as we've ever seen.

The line runs from sea level to points up to 8,300 feet in the mountains of Southern California, with grades over 40%. In places the trench was blasted out of solid rock. It took rugged crews to put the line in and a rugged tape to protect it.

On the recent big Florida Line and other lines in America, on lines in Canada and in Iran, Polyken has proven itself the most practical and economical protection you can put on a pipe.

Polyken tape pays off in performance—and in the currency of less men, less equipment, greater efficiency, more footage per day during construction. With tensioned-spindle equipment, pipe is cleaned, wrapped and over wrapped in one factory-smooth operation. Tape's ready. No primer, no drying or cooling, no fumes or fire hazard—none of those hot-dope problems.

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Seattle, Washington
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J. U. Parker (left), executive member of the National Safety Council and chief safety engineer for Humble Oil & Refining Co., presents award of merit to Henry C. Tooley (center), vice president of manufacturing for W-K-M, and Jim Skipton, W-K-M safety supervisor. The ACF industries division, located in Missouri City, Texas, was honored for its top notch safety record. W-K-M qualified for the award because of its disabling injury-free period of 1,551,590 man-hours from Oct. 1, 1958, to July 12, 1959.

Three-way plan gets FPC okay

Three transmission companies have FPC approval to spend $9.2 million on newly connected facilities in Texas. The companies are Pioneer Gathering System Inc., Amarillo; Permian Basin Pipeline Co., Omaha; and El Paso (Texas) Natural Gas Co.

Pioneer made six filings covering facilities costing $3.6 million. Pioneer can receive into its system gas bought from various Texas producers, transport gas for El Paso under an exchange agreement, and deliver gas to Permian.

El Paso can spend about $849,000 to carry out its part of the exchange deal with Pioneer. Permian's project, costing about $4.7 million, will enable it to receive gas from Pioneer. Permian will sell the gas to its parent, Northern Natural Gas Co.

Capacity of Pioneer's main system is 80 MMcfd. It may be operated to deliver more than 100 MMcfd. Permian will get 38.6 MMcfd from Pioneer. More than 12.5 MMcfd would be transported by Pioneer for El Paso. Pioneer has under contract a total of 343.1 billion cu ft in the various fields.

Permian's project includes 84.6 miles of 16-in. line and a 3960-hp compressor station.

FPC denies El Paso refund rehearing

FPC declined to rehear El Paso Natural Gas Co.'s $18.8 million rate refund case (Docket G-4769). However, the commission stayed provisions of the Aug. 10 action to allow time for filing an appeal for court review, as El Paso indicates it will do.

In its August ruling, FPC said El Paso was entitled to $14.5 million of the wholesale rate it has been collecting since 1954.

Five applications for rehearing were filed with FPC. Four of these objected to FPC's treatment of federal income taxes or returns. In its 12-page opinion, the commission dealt at length with this.

The Aug. 10 ruling permitted El Paso to maintain its 6 per cent rate of return on its properties beyond the wellmouth. But, it allowed the company an 8.61 per cent return on its wellmouth properties, giving it an overall return of 6.35 per cent. The commission held that wellmouth properties must be treated differently. It was the intent of Congress to give gas producers the benefits of special tax incentives relating to liberalized depreciation, intangible well drilling costs, and percentage of income depletion rather than passing them along automatically to consumers as a reduction in cost of service, the FPC said.

T/C has $162 million plan

Trans-Canada Pipe Lines Ltd. will spend $162 million in the next two years. The money will go for expanding markets in eastern Canada and the U. S. Announcement came during a hearing before the Alberta Oil & Gas Conservation Board in which Trans-Canada is seeking permission to export an added 730 billion cu ft of gas during the next 22 years.

United gets new gas supply

Two independent producers can sell their gas to United Gas Pipe Line Co., but for 2 cents less than proposed. Price for the gas from the North Henderson field area of Rusk county, Texas, was set at 15 cents per Mcf.

Last May, a presiding examiner approved the sale without any price condition.

Through a new 14-mile line, United will eventually take 24 MMcfd into its system.

FPC said evidence "was not sufficient to sustain the 17-cent price." This price is about 3 cents higher than the highest rate paid in the area. And, the FPC said, it probably would result in increased field prices by these and other producers for future sales.

The highest price now charged in the area is 14 cents. However, the FPC found justification for the 15-cent rate. It noted that it is a new field and that costs of development would probably be higher than those incurred in older fields nearby. It also pointed out that the new supply will help offset the decline in United's reserves in the area.

Storage company's new tariffs accepted

FPC accepted for filing revised tariff sheets of Natural Gas Storage Co. of Illinois (Docket G-16230). The tariffs affect injection and withdrawal of storage gas.

The revisions provide that: (1) The company will notify its customers by Nov. 1 of each year of the estimated volume of top storage gas that can be injected for the account of each customer during the next injection period. (2) The top storage of any customer is limited to 45 times its withdrawal quantity. (3) All customers are to share in top storage injections in direct proportion to their effective withdrawal amounts. (4) Customers with less than 30 times their withdrawal quantities in storage have first call on injections from day to day.

Utah-Wyoming line okay

Mountain Fuel Supply Co. can build 24.4 miles of 20-in. line (Docket G-18254). The Salt Lake City company's $1.5 million line extends from Coalville, Utah, into Uintah county, Wyo.

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GAS Pipeline People

Maurice N. Day
Mich-Wis.

J. W. Brand
Crose

MAURICE N. DAY is the newly named assistant chief engineer of Michigan Wisconsin Pipe Line and American Louisiana Pipe Line companies, Detroit. He joined Michigan Consolidated Gas Co. in 1949 as junior engineer. Since 1951 he has been assistant to the Mich Con engineer.

J. W. BRAND has been named vice president, M. J. Crose Manufacturing Co. He will headquarter in Tulsa. Brand, also a vice president of Crose-Curran Ltd., will spend considerable time in Canada, directing operations of the Crose subsidiary from Edmonton.

TOM M. LAMBERTH, JR., has been promoted to assistant to the Southwest district manager of Cooper-Bessemer Corp., Mount Vernon, Ohio. He will headquarter in Dallas. New branch manager in Shreveport is CLIFTON W. WOLTZ, succeeding Lamberth.

J. M. BRANNAMAN has been named branch manager of Cooper-Bessemer Corp.'s new field office in Pittsburgh, Pa. This office, under the direct supervision of F. M. Devin, vice president and district manager, will handle sales and engineering contacts in eastern Ohio and western Pennsylvania.

T. M. Lamberth
Cooper

C. W. Woltz
Cooper

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"M-P" MEANS MORE PHASES OF GAS SCRUBBING AND OIL SEPARATION

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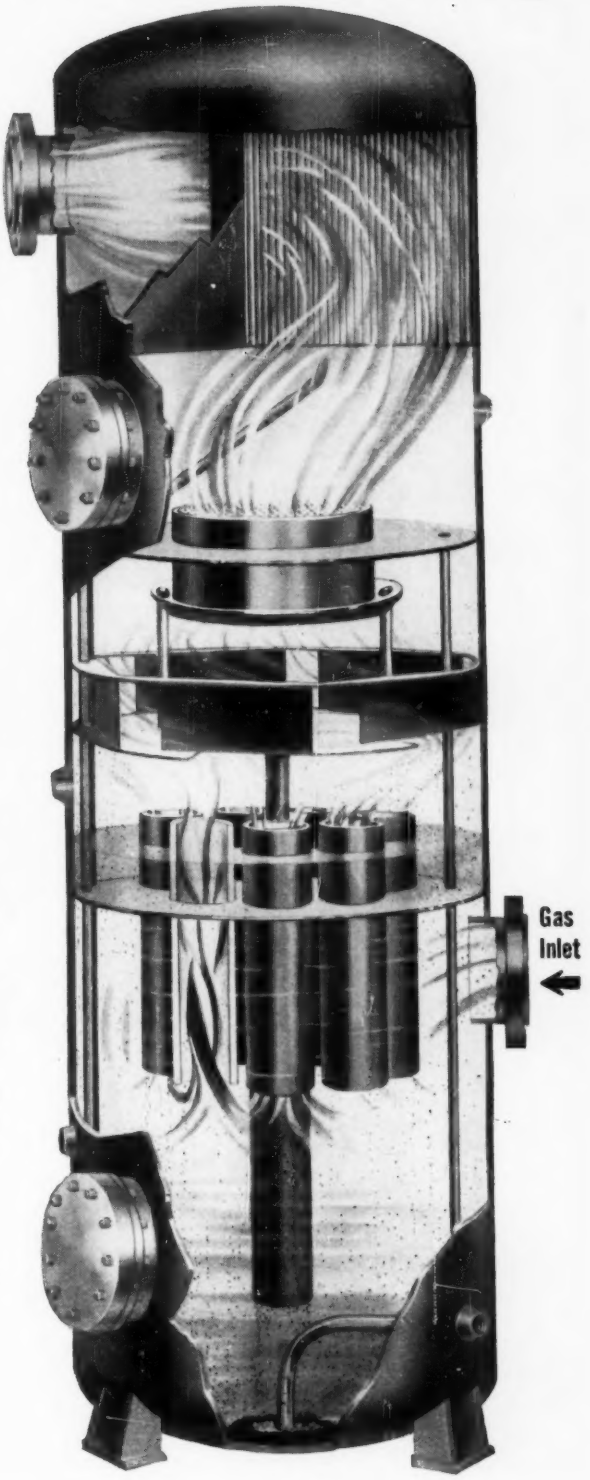

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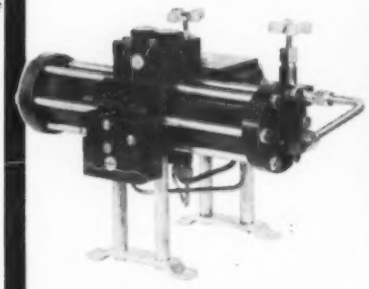

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4015 PV	40 gph	1500 p.s.i.
9015 PV	90 gph	1500 p.s.i.
21015 PV	210 gph	1500 p.s.i.
45015 PV	450 gph	1500 p.s.i.

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Several key appointments have been made by Tennessee Gas Transmission Co., Houston. The promotions are: EDGAR U. COCHRANE from director of industrial relations of TGT to vice president of Tennessee Gas Pipeline Co., a division which operates the firm's pipeline system and gas transmission business. ROLLE KARTER from TGT internal auditor to vice president of Tennessee Gas & Oil Co., operator of the oil and gas exploration and production business. HARLEY F. EAKER from TGT assistant treasurer to vice president of Bay Petroleum Co., operator of the manufacturing and marketing of petroleum products. R. E. MCGEE from assistant treasurer to treasurer of TGT. LEROY CAPPS from chief accountant of Midwestern Gas Transmission Co. to assistant treasurer and director of the budget. CLAUDE LILLY from TGT personnel manager to director of industrial relations, succeeding Cochrane.

E. U. Cochrane
TGT

E. R. Karter
TGT

R. E. McGee
TGT

C. B. Lilly Jr.
TGT

Leroy Capps
TGT

H. F. Eaker
TGT

DEANE BAKER has joined the executive staff of Somerville Construction Co., Ada, Mich. He formerly was with Deane Baker & Associates, Lubbock, Texas. In his new post, Baker will work in all phases of executive responsibility for public relations.

Four men have been raised to superintendents and two to assistant superintendents in the Youngstown (Ohio) Sheet & Tube Co.'s Youngstown district operations. J. PAUL TIERNEY is superintendent of the rod, wire, and conduit departments at the Struthers plant. WALTER J. PROCHAK heads the cold drawn bar department at Brier Hill plant. ROBERT G. GRIFFITH is superintendent of the seamless tube mills at Campbell works. GLYN ROBERTS heads the property protection department. Assistant superintendents are MARCUS V. APPLEMAN, couplings department at Campbell, and R. J. BARTHOLOMY, open hearth department at Campbell.

DOUGLAS E. ROOD has joined the Corr-Prev Division of Chase & Sons Inc., North Quincy, Mass. He will serve as manager of the Southwest area, Houston.

Retirement of L. S. ALLEN as head of National Tank Co.'s Armco Surface Casing Division has resulted in several appointments. JOHN H. SHELTON succeeds Allen. Shelton has been manager of National's West Texas division. Assisting Shelton is DALE WILLIAMS. JACK WILLIAMS replaces Shelton in the West Texas post. Succeeding Jack Williams as manager of the Odessa branch is HAROLD JONES. J. D. FOWLER, sales and service engineer for the past three years, succeeds Jones as branch manager at Farmington, N. M.

WILLIAM T. MCLAUGHLIN has been promoted to field sales manager for the Protective Coatings division of Pittsburgh (Pa.) Coke & Chemical Co. He formerly was marketing manager. In his new post, McLaughlin will supervise the division's nationwide sales.

imagination set his course

Black seas, starless skies . . .
no charts or maps to guide him.
But Columbus never faltered.
And a New World was added to the Old.

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SUBSIDIARIES: Midwestern Gas Transmission Company • Tennessee Life Insurance Company • AFFILIATE: Petro-Tex Chemical Corp.

GAS

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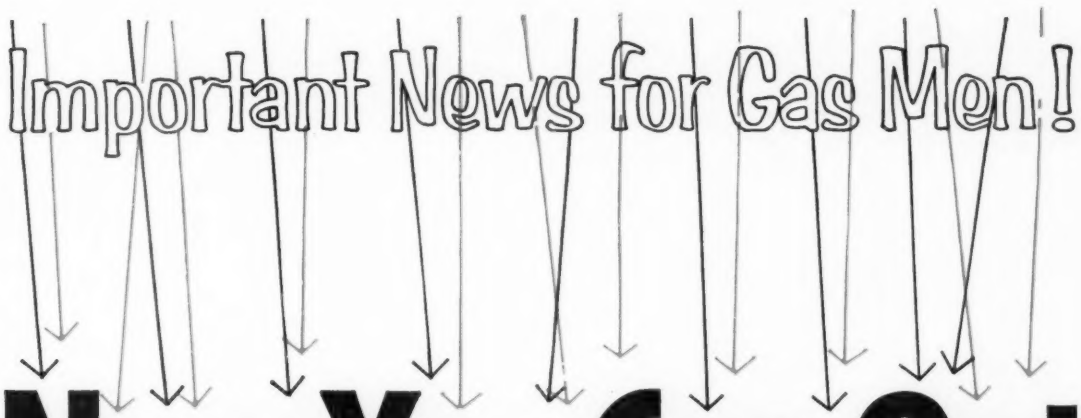

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